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SPECIAL SCIENTIFIC REPORT–FISHERIES No. 422

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

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RECORDS AND OBSERVATIONS FROM PLANKTON GRID STUDIES OFF BAJA CALIFORNIA, APRIL 1952

by

David Kramer

United States Fish and Wildlife Service
Special Scientific Report--Fisheries No. 422

Washington, D.C.
September 1963

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RECORDS AND OBSERVATIONS FROM PLANKTON GRID STUDIES OFF BAJA CALIFORNIA, APRIL 1952

by

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ABSTRACT

Data are presented for a grid survey conducted for 5 days in April 1952. The cruise was made by three vessels; one made a daily survey of a square grid of 25 stations spaced 4 miles apart, one maintained an anchor station on this pattern, and one followed a 10-meter drogue drifting through the pattern.

The data deal with the eggs and larvae of the Pacific sardine *(Sardinops caerulea)* and the larvae of other commercial species; the northern anchovy *(Engraulis mordax)*, the jack mackerel *(Trachurus symmetricus)*, the Pacific mackerel *(Pneumatophorus diego)*, the hake *(Merluccius productus)*, and rockfish *(Sebastodes* spp.). All the above larvae except those of the hake and rockfish are reported by size. Data are also included for the larvae of a deep-sea smelt *Leuroglossus stilbius*, and a lanternfish *Lampanyctus mexicanus*, because of their abundance on this survey. Distribution diagrams show the more abundant fish larvae and plankton volumes on the grids. Plankton volumes are reported and differences in day and night collections are discussed.

Introduction

This paper reports on the data gathered on a special cruise made in April 1952. The work was designed to investigate some of the problems encountered in the sampling techniques of the California Cooperative Oceanic Fisheries Investigations (CalCOFI) in monthly surveys off the Pacific coast of the United States and Baja, California.

The CalCOFI are sponsored by the California Marine Research Committee. The cooperating agencies in these investigations are the U.S. Bureau of Commercial Fisheries, the Scripps Institution of Oceanography, the California Department of Fish and Game, Hopkins Marine Station of Stanford University and the California Academy of Sciences.

The data are presented in figures and tables in the same manner as the data reported by the Bureau of Commercial Fisheries Biological Laboratory at La Jolla, Calif., on the sardine eggs and larvae and other fish larvae for 1950-57 (Ahlstrom, 1952, 1953, 1954a, 1958, 1959; Ahlstrom and Kramer, 1955, 1956, 1957). The fish larvae reported for this cruise include the following commercial species: Pacific sardine *(Sardinops caerulea)*, northern anchovy *(Engraulis mordax)*, jack mackerel *(Trachurus symmetricus)*, Pacific mackerel *Pneumatophorus diego*, hake *(Merluccius productus)*, and rockfish *(Sebastodes* spp.). Two other species are included because of their

abundance during this survey: a deep-sea smelt *(Leuroglossus stilbius)* and a lanternfish *(Lampanyctus mexicanus)*. The report also records the plankton volumes at all the stations on the survey. Plankton volumes are reported annually by this laboratory (Staff, South Pacific Fishery Investigations, 1952 through 1956; Thrailkill, 1957, 1959, 1961); but the plankton data for this special cruise have not been reported previously.

SURVEY DESIGN

The survey was designed with the following objectives: First, to determine short-period (1-day) time changes in distribution and numbers of planktonic organisms, particularly sardine eggs and larvae. A close-spaced grid (gridiron) in a 16-mile square of 25 "grid stations" (stations 4 miles apart) was established south of Punta Eugenia, Baja California (fig. 1).[1] This square represented a statistical area of 400 square miles (20 miles to a side), one-fourth of that assigned to a station (stations 40 miles apart) on the regular CalCOFI pattern. Second, to observe the hydrographic and biological changes at a fixed point. An "anchor station" marked by a fixed buoy was placed at grid-station 3, which is also the regular CalCOFI station 123.40. Third, to observe a single water mass, its movements and its constituents. A "drogue station" was established with a 10-meter drogue attached to a buoy. Its position was determined by currents at that level, and observations at times designated for stations were made at the buoy wherever it was found.

METHODS OF SAMPLING

The survey was made April 18-23 by the research vessels the *Black Douglas* of the Bureau of Commercial Fisheries and the *Crest* and *Horizon* of the Scripps Institution of Oceanography. The *Black Douglas* and the *Crest* alternated on the grid pattern and anchor station, the former covering the pattern on the first, third, and fifth days. The *Horizon* sampled at the drogue stations for the full time of the investigation.

Hydrographic and biological observations and collections followed the standard procedure of the CalCOFI cruises (Ahlstrom, 1952). At grid stations these included one 200-meter net tow for plankton, one 10-meter hydrographic cast for temperature and salinity, one 900-foot bathythermograph (BT) cast, and observations of meterological data. Drogue and anchor stations were made every 4 hours. These observations and collections were the same as those of the grid stations, but with standard hydrographic casts to 600 meters. Additional data from the drogue stations included bacteriological samples collected with Johnson-ZoBell (J-Z) bottles on the hydrographic casts. The drogue ship also conducted current observations (GEK) in the intervals between stations. Station data are shown in table 1.

The 25 stations on the grid covered on the first day will be referred to as Grid I (GI-1 to GI-25), those of the next day, Grid II (GII-1 to GII-25), etc., for a total of 125 stations during the 5-day survey. During the same period, 30 drogue stations (D-1 to D-30) and 30 anchor stations (A-1 to A-30) were occupied.

The 10-meter drogue drifted in a southerly current for about 75 nautical miles from its northernmost station, D-2 (fig. 1).

The anchor-station buoy broke loose after the first six observations. This station was then maintained by navigation, placing most of the following observations within 2 or 3 miles of the original position. An error in navigation placed the last six stations about 7 miles south of the original position (table 1).

SARDINE EGGS

Sardine eggs, listed by age in days (as described by Ahlstrom, 1943), are reported as numbers of normal eggs and total number of eggs (table 2). The totals in excess of the numbers of normal eggs include abnormal eggs that had stunted, discolored, and misshapen embryos. Unclassified eggs are those too deteriorated for aging.

[1] The grid location was determined by two consecutive surveys of the CalCOFI pattern off central Baja California during late March and early April. Final observations on the last cruise were taken only 2 days before the survey began.

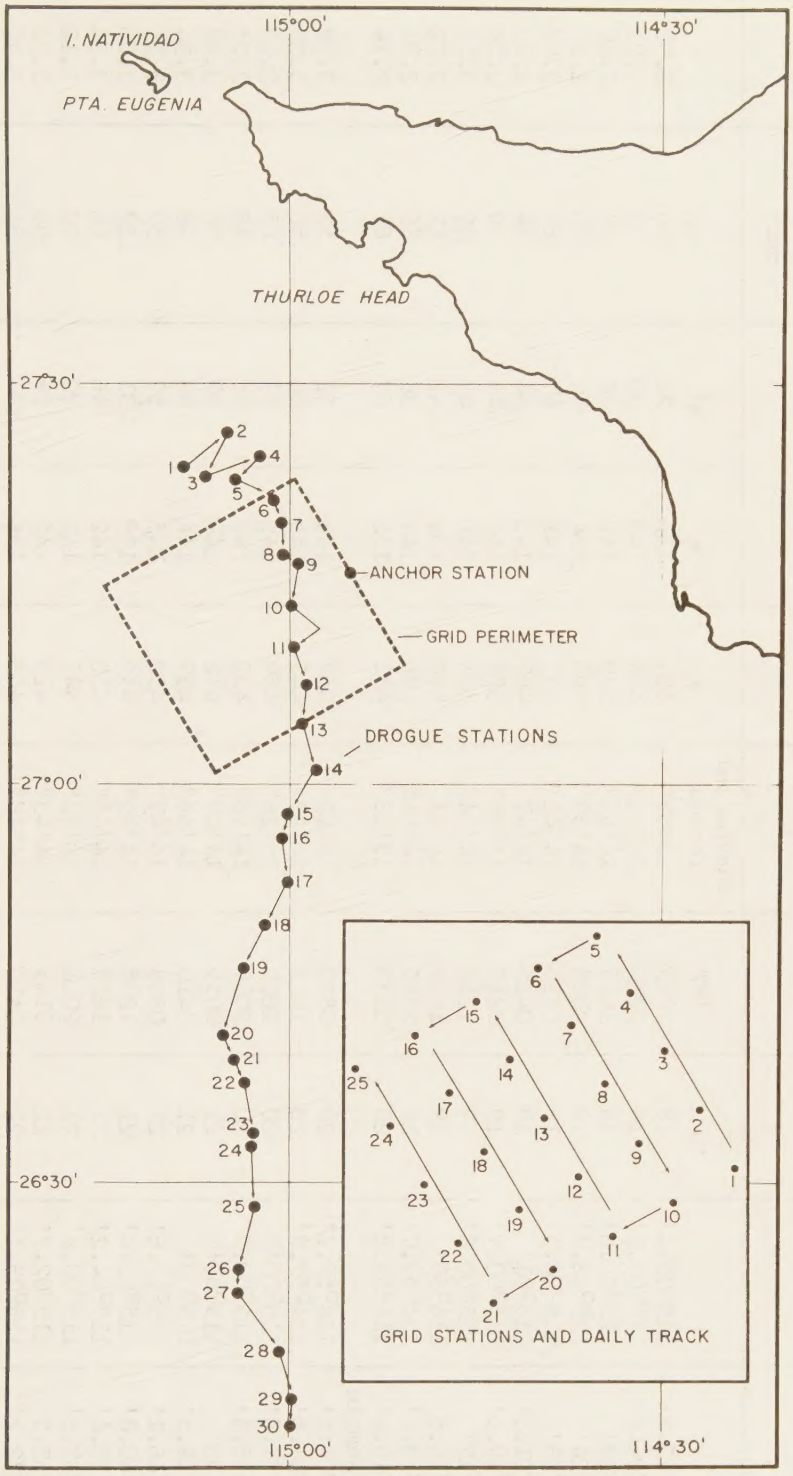

Figure 1. Drogue trajectory and stations, grid perimeter and anchor station covered on three-ship survey, April 18-23, 1952. Insert:--stations and track followed on grid coverage.

Table 1.--Station data: grid studies, April 1952

Station	Position		Date	Time of tow[1]	Duration of haul	Volume water strained	Depth of haul	Plankton volume per 1,000 m.^{3} water strained		Standard haul factor
	Latitude N.	Longitude W.						Total	Small organisms only	
Drogue			*April*	*PST*	*Minutes and seconds*	*m.*	*m.*	*ml.*	*ml.*	
D-1	27°23.8'	115°03.4'	18	1005	15'09"	504	136	26	26	2.70
D-2	27°26.4'	115°05.1'	18	1210	14'32"	435	140	30	30	3.21
D-3	27°23'	115°06.8'	18	1615	14'45"	539	140	48	48	2.60
D-4	27°24'	115°02.3'	18	2005	14'39"	568	124	60	60	2.18
D-5	27°23'	115°04.1'	19	0010	14'41"	475	141	67	67	2.97
D-6	27°21.5'	115°01'	19	0415	14'47"	497	143	84	84	2.88
D-7	27°19.5'	115°00.7'	19	0810	14'39"	508	140	49	49	2.76
D-8	27°17'	115°00.8'	19	1210	14'34"	464	146	47	47	3.15
D-9	27°16.5'	114°59'	19	1615	14'41"	494	134	42	42	2.72
D-10	27°13.4'	114°59.7'	19	2015	14'54"	476	141	88	88	2.96
D-11	27°10.6'	114°59.3'	20	0235	15'13"	481	132	67	67	2.74
D-12	No sample									
D-13	27°04.6'	114°59.2'	20	0810	14'49"	458	146	52	52	3.18
D-14	27°01.5'	114°57.9'	20	1215	14'39"	441	145	50	50	3.28
D-15	26°57.8'	115°00'	20	1605	15'28"	459	149	63	63	3.25
D-16	26°55.8'	115°00.5'	20	2005	14'40"	432	140	88	88	3.25
D-17	26°53'	115°00'	21	0055	14'40"	412	149	90	90	3.62
D-18	26°49.5'	115°02'	21	0410	14'46"	437	146	98	98	3.34
D-19	26°46.1'	115°03.6'	21	0805	14'47"	459	143	59	59	3.11
D-20	26°40.8'	115°05.4'	21	1205	14'35"	455	139	231	130	3.05
D-21	26°39.4'	115°04.2'	21	1610	14'45"	452	142	46	46	3.14
D-22	26°37.5'	115°03.6'	21	2010	14'52"	445	142	90	90	3.12
D-23	26°33.5'	115°02.7'	22	0145	14'43"	425	142	99	99	3.35
D-24	26°32.2'	115°03.1'	22	0410	14'48"	443	138	84	84	3.12
D-25	26°28'	115°03'	22	0815	14'58"	413	147	99	99	3.55
D-26	26°23.2'	115°04'	22	1210	14'45"	446	142	99	99	3.20
D-27	26°21.5'	115°04'	22	1610	14'49"	457	144	96	96	3.15
D-28	26°17'	115°00.8'	22	2015	15'02"	401	159	127	127	3.96
D-29	26°13.5'	114°59.8'	23	0015	14'56"	531	123	139	139	2.32
D-30	26°11.5'	114°59.9'	23	0405	14'50"	427	146	117	117	3.43

Table 1.--Station data: grid studies, April 1952--Continued

Station	Position		Date	Time of tow[1]	Duration of haul	Volume water strained	Depth of haul	Plankton volume per 1,000 m.^{3} water strained		Standard haul factor
	Lathitude N.	Longitude W.						Total	Small organisms only	
Anchor			*April*	*PST*	*Minutes and seconds*	*m.*	*m.*	*ml.*	*ml.*	
A-1	27°15.8'	114°54.9'	18	0850	14'32"	482	139	17	17	2.88
A-2	27°15.8'	114°54.9'	18	1210	14'27"	426	148	40	40	3.46
A-3	27°15.8'	114°54.9'	18	1610	14'30"	472	138	32	32	2.93
A-4	27°15.8'	114°54.9'	18	2010	14'28"	462	136	58	58	2.93
A-5	27°15.8'	114°54.9'	19	0010	14'37"	441	142	41	41	3.22
A-6	27°15.8'	114°54.9'	19	0410	14'30"	455	141	40	40	3.10
A-7	27°16'	114°55.2'	19	0810	14'34"	508	136	45	45	2.68
A-8	27°16'	114°55.2'	19	1210	14'30"	497	142	42	42	2.86
A-9	27°17.5'	114°55'	19	1610	14'26"	504	137	56	56	2.73
A-10	27°14.5'	114°53'	19	2220	14'34"	495	141	61	61	2.85
A-11	27°14.5'	114°54'	20	0616	14'31"	478	142	61	61	2.97
A-12	27°15.5'	114°54.5'	20	0410	14'44"	457	141	66	66	3.08
A-13	27°15'	114°53.5'	20	0810	14'35"	472	139	47	47	2.94
A-14	27°15'	114°53.5'	20	1210	14'38"	478	137	33	33	2.87
A-15	27°15'	114°53.5'	20	1610	14'07"	429	135	37	37	3.15
A-16	27°15'	114°53.5'	20	2010	14'31"	434	142	64	64	3.27
A-17	27°15'	114°53.5'	21	0010	14'38"	444	141	56	56	3.18
A-18	27°15'	114°53.5'	21	0410	14'20"	432	141	60	60	3.26
A-19	27°16.5'	114°55'	21	0810	14'30"	484	138	70	70	2.84
A-20	27°15.5'	114°55'	21	1210	14'37"	486	138	58	58	2.83
A-21	27°15.5'	114°56'	21	1610	14'34"	480	141	42	42	2.94
A-22	27°16.5'	114°56'	21	2010	14'40"	512	136	74	74	2.65
A-23	27°15'	114°55.5'	22	0010	15'22"	519	128	77	77	2.46
A-24	27°14'	114°56'	22	0410	14'29"	503	132	72	72	2.62
A-25	27°08.5'	114°53.5'	22	0810	14'31"	488	132	45	45	2.70
A-26	27°08.5'	114°53.5'	22	1210	14'27"	456	142	39	39	3.12
A-27	27°08.5'	114°53.5'	22	1605	14'09"	396	159	48	48	4.00
A-28	27°08.5'	114°53.5'	22	2010	14'26"	442	141	72	72	3.18
A-29	27°08.5'	114°53.5'	23	0010	14'32"	446	137	72	72	3.07
A-30	27°08.5'	114°53.5'	23	0415	13'46"	447	127	74	74	2.83

Table 1.--Station data: grid studies, April 1952--Continued

Station	Position		Date	Time of tow[1]	Duration of haul	Volume water strained	Depth of haul	Plankton volume per 1,000 m.³ water strained		Standard haul factor
	Latitude N.	Longitude W.						Total	Small organisms only	
Grid I			*April*	*PST*	*Minutes and seconds*	*m.*	*m.*	*ml.*	*ml.*	
GI-1	27°06'	114°50.5'	18	0810	14'32"	524	136	32	32	2.59
GI-2	27°12.5'	114°53'	18	0855	14'25"	496	141	58	58	2.84
GI-3	27°16'	114°55'	18	0930	14'33"	496	142	38	38	2.86
GI-4	27°19.2'	114°57.5'	18	1015	14'34"	489	142	41	41	2.90
GI-5	27°23'	114°59.5'	18	1055	14'35"	496	142	48	48	2.86
GI-6	27°21'	115°03.5'	18	1130	14'34"	500	138	22	22	2.77
GI-7	27°17.5'	115°01'	18	1210	14'27"	485	141	27	27	2.91
GI-8	27°14'	114°59'	18	1255	14'36"	507	139	71	71	2.74
GI-9	27°10.5'	114°56.5'	18	1335	14'28"	496	139	48	48	2.81
GI-10	27°07'	114°54.5'	18	1420	14'28"	492	141	83	83	2.86
GI-11	27°05'	114°58.5'	18	1450	14'30"	506	142	67	67	2.80
GI-12	27°08.5'	115°00.5'	18	1535	14'32"	503	142	38	38	2.82
GI-13	27°12'	115°03'	18	1615	14'30"	534	133	30	30	2.49
GI-14	27°15.4'	115°05'	18	1700	14'35"	539	133	35	35	2.47
GI-15	27°19'	115°07.5'	18	1740	14'28"	499	139	58	58	2.78
GI-16	27°17'	115°11'	18	1825	14'27"	488	138	100	100	2.83
GI-17	27°13.2'	115°09'	18	1905	14'42"	503	138	88	88	2.74
GI-18	27°10'	115°06.8'	18	1950	14'30"	495	140	83	83	2.82
GI-19	27°06.4'	115°04.6'	18	2030	14'40"	489	140	119	119	2.86
GI-20	27°03'	115°02.5'	18	2110	14'30"	478	140	127	127	2.93
GI-21	27°01'	115°06'	18	2150	14'28"	477	141	220	220	2.96
GI-22	27°04.5'	115°08.5'	18	2235	14'28"	480	147	175	175	3.06
GI-23	27°08.1'	115°10.6'	18	2320	14'35"	499	139	154	154	2.78
GI-24	27°11.5'	115°13'	18&19	0005	14'31"	490	142	1,093	1,093	2.90
GI-25	27°15'	115°15'	19	0050	14'35"	500	142	150	150	2.84
Grid II										
GII-1	27°09'	114°50.8'	19	0810	14'26"	470	139	40	40	2.96
GII-2	27°12.6'	114°52.8'	19	0850	15'00"	385	150	31	31	3.90
GII-3	27°16'	114°55'	19	0940	14'30"	424	141	33	33	3.33
GII-4	27°19.5'	114°57.2'	19	1020	14'27"	419	145	43	43	3.45
GII-5	27°23'	114°59.5'	19	1110	14'27"	412	142	44	44	3.44

Table 1.--Station data: grid studies, April 1952--Continued

Station	Position		Date	Time of tow[1]	Duration of haul	Volume water strained	Depth of haul	Plankton volume per 1,000 m.^{3} water strained		Standard haul factor
	Latitude N.	Longitude W.						Total	Small organisms only	
Grid II			*April*	*PST*	*Minutes and seconds*	*m.*	*m.*	*ml.*	*ml.*	
GII-6	27°21'	115°03.4'	19	1145	14'36"	399	147	55	55	3.68
GII-7	27°17.5'	115°01'	19	1240	14'47"	375	142	40	40	3.80
GII-8	27°14'	114°59'	19	1325	14'39"	437	137	32	32	3.13
GII-9	27°10.5	114°56.5'	19	1410	14'41"	422	143	52	52	3.38
GII-10	27°07'	114°54.5'	19	1500	14'37"	432	136	37	37	3.15
GII-11	27°05'	114°58.5'	19	1545	14'35"	419	141	53	53	3.37
GII-12	27°08.5'	115°00.5'	19	1630	13'37"	370	144	73	73	3.90
GII-13	27°11.9'	115°02.8'	19	1715	13'51"	440	140	57	57	3.19
GII-14	27°15.5'	115°05'	19	1820	13'35"	426	141	68	68	3.30
GII-15	27°18.9'	115°07.2'	19	1900	13'44"	418	145	55	55	3.46
GII-16	27°16.9'	115°11.1'	19	1950	13'43"	405	140	101	101	3.45
GII-17	27°13.5'	115°09.8'	19	2035	14'31"	438	145	91	91	3.30
GII-18	27°10'	115°06.5'	19	2120	14'24"	398	153	83	83	3.85
GII-19	27°06.5'	115°04.5'	19	2205	14'34"	454	142	108	108	3.14
GII-20	27°03'	115°02.3'	19	2250	14'29"	438	143	94	94	3.26
GII-21	27°01'	115°06.2'	19	2335	14'22"	451	135	84	84	2.99
GII-22	27°04.5'	115°09'	20	0015	14'32"	444	143	90	90	3.22
GII-23	27°08'	115°10.5'	20	0110	14'38"	431	147	74	74	3.42
GII-24	27°11.5'	115°13'	20	0145	14'37"	427	145	73	73	3.39
GII-25	27°15'	115°15'	20	0240	14'37"	428	147	82	82	3.44
Grid III										
GIII-1	27°08'	114°50.6	20	0810	14'29"	496	134	52	52	2.70
GIII-2	27°12.5'	114°53'	20	0915	14'31"	488	139	25	25	2.86
GIII-3	27°16'	114°52.2'	20	1015	14'30"	499	131	80	80	2.63
GIII-4	27°19'	114°54.4'	20	1105	14'35"	463	139	82	82	2.99
GIII-5	27°23'	114°59.2	20	1145	14'39"	486	137	70	70	2.82
GIII-6	27°21'	115°03.4'	20	1225	14'30"	476	140	21	21	2.94
GIII-7	27°17.5'	115°01'	20	1310	14'39"	483	140	21	21	2.90
GIII-8	27°14'	114°59'	20	1350	14'36"	474	138	44	44	2.91
GIII-9	27°10.5'	114°56.5'	20	1430	14'28"	459	141	46	46	3.07
GIII-10	27°07'	114°54.5'	20	1510	14 31"	479	135	33	33	2.82

Table 1.--Station data: grid studies, April 1952--Continued

Station	Position		Date	Time of tow[1]	Duration of haul	Volume water strained	Depth of haul	Plankton volume per 1000 m^3 water strained		Standard haul factor
	N. Longitude	W. Latitude						Total	Small organisms only	
Grid III			*April*	*PST*	*Minutes and seconds*	*m.*	*m.*	*ml.*	*ml.*	
GIII-11	27°05'	114°58.5'	20	1545	14'30"	471	141	68	68	2.99
GIII-12	27°08.5'	115°00.5'	20	1630	14'30"	487	140	60	60	2.87
GIII-13	27°12'	115°03'	20	1710	14'31"	480	139	60	60	2.89
GIII-14	27°15.4'	115°05'	20	1755	14'31"	478	139	59	59	2.91
GIII-15	27°19'	115°07'	20	1845	14'41"	504	139	87	87	2.76
GIII-16	27°17'	115°11'	20	1930	14'34"	488	138	123	123	2.82
GIII-17	27°13'	115°09'	20	2015	14'30"	490	137	129	129	2.80
GIII-18	27°10'	115°06.8'	20	2055	14'41"	481	138	127	127	2.88
GIII-19	27°06.4'	115°04.6'	20	2140	14'35"	483	140	120	120	2.90
GIII-20	27°03'	115°02.5'	20	2225	14'33"	478	141	117	117	2.94
GIII-21	27°01'	115°06.5'	20	2350	14'40"	506	140	89	89	2.76
GIII-22	27°04.5'	115°08.5'	21	0035	14'30"	488	140	76	76	2.86
GIII-23	27°08.5'	115°10.6'	21	0120	14'30"	472	140	138	138	2.96
GIII-24	27°11.5'	115°13'	21	0205	14'34"	473	141	108	108	2.98
GIII-25	27°15'	115°15'	21	0250	14'34"	470	139	72	72	2.96
Grid IV										
GIV-1	27°09'	114°50.8'	21	0810	14'39"	498	127	36	36	2.55
GIV-2	27°12.6'	114°52.8'	21	0855	14'24"	464	134	60	60	2.89
GIV-3	27°16'	114°55'	21	0955	14'32"	423	143	52	52	3.38
GIV-4	27°19.5'	114°57.2'	21	1040	14'28"	439	131	32	32	2.98
GIV-5	27°23'	114°59.5'	21	1125	14'28"	442	140	43	43	3.17
GIV-6	27°21'	115°03.4'	21	1210	14'37"	443	141	38	38	3.19
GIV-7	27°17.5'	115°01'	21	1255	14'37"	449	136	31	31	3.04
GIV-8	27°14'	114°59'	21	1335	14'37"	425	143	24	24	3.36
GIV-9	27°10.5'	114°54.5'	21	1425	14'32"	434	139	25	25	3.20
GIV-10	27°07'	114°54.5'	21	1510	14'34"	430	140	51	51	3.27
GIV-11	27°05'	114°58.5'	21	1555	14'32"	422	144	36	36	3.41
GIV-12	27°08.5'	115°00.5'	21	1640	14'05"	401	144	27	27	3.59
GIV-13	27°12'	115°03'	21	1735	13'59"	407	144	25	25	3.54
GIV-14	27°15.5'	115°05'	21	1825	14'14"	420	143	41	41	3.41
GIV-15	27°19'	115°07.5'	21	1915	13'59"	388	145	62	62	3.74

Table 1.--Station data: grid studies, April 1952--Continued

Station	Position		Date	Time of tow[1]	Duration of haul	Volume water strained	Depth of haul	Plankton volume per 1,000 m.[3] water strained		Standard haul factor
	Latitude N.	Longitude W.						Total	Small organisms only	
Grid IV			*April*	*PST*	*Minutes and seconds*	*m.*	*m.*	*ml.*	*ml.*	
GIV-16	27°17'	115°11.5'	21	1945	14'05"	382	146	60	60	3.82
GIV-17	27°13.5'	115°09.8'	21	2035	14'28"	418	146	335	270	3.48
GIV-18	27°10'	115°06.5'	21	2120	14'29"	426	145	73	73	3.40
GIV-19	27°06.5'	115°04.5	21	2210	14'2[illegible]"	434	142	53	53	3.26
GIV-20	27°03'	115°02.3	21	2245	14'29"	437	145	53	53	3.32
GIV-21	27°01'	115°06.2'	21	2325	14'28"	436	141	80	80	3.24
GIV-22	27°04.5'	115°09'	22	0015	14'36"	423	145	80	80	3.43
GIV-23	27°08'	115°10.5'	22	0100	14'38"	434	139	76	76	3.20
GIV-24	27°11.5'	115°13'	22	0150	14'33"	425	140	78	61	3.30
GIV-25	27°15'	115°15'	22	0240	14'35"	428	141	67	67	3.35
Grid V										
GV-1	27°09.5'	114°52.5'	22	0810	14'03"	483	134	83	83	2.77
GV-2	27°13'	114°55'	22	0855	14'18"	491	137	55	55	2.80
GV-3	27°16'	114°55'	22	0950	14'15"	486	137	37	37	2.82
GV-4	27°19.2'	114°58'	22	1025	14'15"	486	140	58	58	2.89
GV-5	27°23'	114°59.5'	22	1110	14'08"	464	138	39	39	2.97
GV-6	27°21'	115°03.5'	22	1140	14'19"	492	139	89	89	2.82
GV-7	27°17.5'	115°01'	22	1230	14'32"	464	141	91	91	3.04
GV-8	27°14'	114°59'	22	1310	14'30"	465	141	58	58	3.04
GV-9	27°10'	114°56.5'	22	1350	14'31"	465	144	108	108	3.09
GV-10	27°07'	114°54.5'	22	1425	14'29"	463	139	52	52	3.00
GV-11	27°05'	114°58.5'	22	1510	14'35"	473	142	228	228	3.00
GV-12	27°08.5'	115°00.5'	22	1550	14'23"	469	142	62	62	3.04
GV-13	27°12'	115°03'	22	1635	14'30"	475	142	29	29	2.[illegible]
GV-14	27°15.4'	115°05'	22	1720	14'35"	473	142	49	49	3.01
GV-15	27°19'	115°07.5'	22	1805	14'31"	474	142	53	53	3.00
GV-16	27°17'	115°11'	22	1845	14'20"	468	140	75	75	3.00
GV-17	27°13.2'	115°09'	22	1925	14'31"	469	137	94	94	2.92
GV-18	27°10'	115°06.8'	22	1955	14'35"	488	134	100	100	2.75
GV-19	27°06.4'	115°04.6'	22	2035	14'33"	460	136	96	96	2.9[illegible]

Table 1.--Station data: grid studies, April 1952--Continued

Station	Position		Date	Time of tow[1]	Duration of haul	Volume water strained	Depth of haul	Plankton volume per 1,000 m.^{3} water strained		Standard haul factor
	Latitude N.	Longitude W.						Total	Small organisms only	
Grid V			*April*	*PST*	*Minutes and seconds*	*m.*	*m.*	*ml.*	*ml.*	
GV-20	27°03'	115°02.5'	22	2115	14'32"	466	136	54	54	2.92
GV-21	27°01'	115°06'	22	2200	14'30"	470	135	91	91	2.87
GV-22	27°04.5'	115°08.5'	22	2245	14'29"	460	135	78	78	2.94
GV-23	27°08.1'	115°10.6'	22	2330	14'32"	470	137	72	72	2.91
GV-24	27°11.5'	115°13'	23	0015	14'30"	469	138	85	85	2.94
GV-25	27°15'	115°15'	23	0100	14'30"	454	143	60	60	3.14

[1] Nearest 5 minutes to mid-point of tow.

Age categories, A to D, into which sardine eggs are classified, are as follows:

A- 1 day old. Eggs spawned within 24 hours of collection.
B- 2 days old. Eggs spawned between 24.1 to 48 hours of collection.
C- 3 days old. Eggs spawned between 48.1 to 72 hours of collection.
D- 4 days old. Eggs spawned between 72.1 to 96 hours of collection.
Unclassified (uncl.). Deteriorated eggs.

A dash (-) in table indicates an age category which could not be present because temperatures were high enough to have hatched the eggs before they reached that age.

A zero (0) value indicates that although no eggs were taken they could have been present according to temperature and time of collection.

Sardine eggs were collected at every drogue station with the greatest numbers per haul occurring in the grid area (table 2a). New spawning occurred throughout the range of the drogue trajectory. Ten-meter temperatures ranged from 15.71° to 16.26° C. which allowed for a maximum embryonic period of only 3 days, except at station D-28 where a few 4-day-old eggs were collected and at station D-29, where, although no eggs were collected, 4-day-olds could have been present, although temperatures at these stations were 16.23° C. and 16.19° C. respectively. Four-day-olds at station D-28 were present either because the eldest category was just over 3 days from spawning (in fact only one-quarter of an hour over) or they might have been taken from colder regions below the 10-meter level and had a longer period of development. The possibility of 4-day-old eggs at station D-29 can be reasoned only on the basis of time of collection. Samples at the anchor station were collected from water that had been transported southward to that area. Egg collections during the first 3 days showed that very little new spawning was occurring. On the fourth and fifth days of collection, however, new spawning became heavy (table 2a, stations A-19 and A-29). Temperatures ranged from 15.67° to 16.23° C., allowing for only 3 days from spawning to hatching.

Sardine eggs, 1 to 3 days old, were collected every day on the grid pattern. The greatest concentrations were usually in the eastern (inshore) half of the grid (fig. 2). On the first 3 days of coverage there were no eggs at some of the stations. On the fourth and fifth days, eggs were found at all stations. These were primarily 1-day-old eggs on Grid IV and 1- and 2-day-old eggs on Grid V (table 2b).

The current through the grid, as demonstrated by the drogue trajectory, probably changed the egg and larval population once each day. Thus, each day's older eggs were those spawned in areas north of the grid. When collections were begun at 0800 hours on each day, both 1-day-old eggs and previously spawned eggs were present in the grid and north of it. By the time the ship reached the western section of the grid at 2000 hours, new spawning had begun. The eggs, which had been to the north at the beginning of the day's sampling run had moved into the grid, were 12+ hours older and had entered their next age category. Because sampling the grid was an attempt to obtain each day's eggs as a single unit, these advanced eggs were listed by their spawning day and consequently in the same age category as those collected earlier, as though they had been collected simultaneously over the entire grid. Eggs spawned after 2000 hours in each day's grid collections are listed only under a date of spawning in the age category columns (table 2b). When collections began again on each following day, those eggs were out of the grid, but the 1-day-old group from north of the grid was being sampled in that day's collections and were thus listed as 1-day eggs.

FISH LARVAE

The differences in numbers of the different species of larvae in this survey reflect both differences in the relative numbers of adults in the area and the relation of the time of the survey to the time of peak spawning for each species. Of the larvae, sardines were the most abundant, for they represented about 71 percent of all larvae taken by all ships during the 5-day survey, 67 percent of all larvae taken in the five grids, 79 percent of all larvae taken on the anchor stations, and 81 percent of all larvae taken at the drogue stations (table 3; fig. 3). The larvae of other commercial

Table 2a.--Sardine eggs, by age in days, collected on drogue and anchor stations.

Station	Number of normal eggs				Total number of eggs					
	A	B	C	D	A	B	C	D	Unclassified	N
Drogue										
D-1	176	3	0	-	329	3	0	-	14	346
D-2	331	42	0	-	636	61	0	-	10	707
D-3	190	29	0	-	629	55	0	-	78	762
D-4	0	421	266	-	0	654	334	-	48	1,036
D-5	0	184	65	-	0	368	113	-	50	531
D-6	12	233	43	-	17	380	92	-	86	575
D-7	177	455	179	-	248	651	243	-	64	1,206
D-8	142	680	258	-	227	797	268	-	22	1,314
D-9	101	617	63	-	185	797	71	-	38	1,091
D-10	0	89	651	-	0	166	858	-	50	1,074
D-11	0	27	458	-	0	41	501	-	6	548
D-12	No sample.									
D-13	0	35	340	-	0	44	369	-	0	413
D-14	0	43	151	-	0	82	190	-	7	279
D-15	0	29	32	-	0	45	39	-	0	84
D-16	0	3	26	-	0	3	32	-	0	35
D-17	0	0	29	-	0	0	29	-	0	29
D-18	0	0	43	-	0	0	43	-	0	43
D-19	0	0	22	-	0	0	34	-	0	34
D-20	6	3	27	-	6	3	30	-	0	39
D-21	3	3	-	-	3	3	-	-	0	6
D-22	0	6	3	-	0	6	3	-	0	9
D-23	0	0	3	-	0	0	7	-	0	7
D-24	22	0	6	-	94	0	9	-	9	112
D-25	124	0	0	-	195	0	0	-	7	202
D-26	35	3	0	-	67	3	0	-	3	73
D-27	41	0	-	-	107	3	-	-	0	110
D-28	0	24	0	8	0	32	8	8	0	48
D-29	0	0	0	0	0	0	0	0	0	0
D-30	0	3	0	-	0	3	0	-	0	3
Total	1,360	2,932	2,665	8	2,743	4,200	3,273	8	492	10,716

Table 2a.--Sardine eggs, drogue and anchor stations--Continued

Station	Number of Normal Eggs				Total Number of Eggs					
	A	B	C	D	A	B	C	D	Unclassified	n
Anchor										
A-1	0	536	798	-	0	1,264	1,884	-	276	3,424
A-2	0	2,090	813	-	0	2,432	1,076	-	38	3,546
A-3	9	1,424	18	-	9	1,749	18	-	9	1,785
A-4	0	15	1,054	-	0	26	1,313	-	0	1,339
A-5	0	3	448	-	0	3	1,137	-	19	1,159
A-6	3	0	763	-	3	0	995	-	0	998
A-7	0	0	1,032	-	0	0	1,032	-	0	1,032
A-8	6	0	315	-	14	0	383	-	3	400
A-9	33	16	49	-	49	16	66	-	0	131
A-10	0	9	9	-	0	17	83	-	37	137
A-11	0	77	80	-	0	86	107	-	0	193
A-12	0	46	6	-	0	108	19	-	15	142
A-13	0	418	400	-	0	747	576	-	41	1,364
A-14	17	207	276	-	17	258	321	-	0	596
A-15	13	107	3	-	85	205	44	-	35	369
A-16	0	62	33	-	0	160	46	-	29	235
A-17	0	293	38	-	0	369	57	-	19	445
A-18	522	6	26	-	926	6	26	-	98	1,056
A-19	2,016	6	28	-	2,607	11	40	-	57	2,715
A-20	1,460	0	17	-	2,587	0	17	-	40	2,644
A-21	1,064	24	0	-	2,846	35	0	-	206	3,087
A-22	0	928	21	-	0	1,866	26	-	238	2,130
A-23	0	3,975	128	-	0	4,753	167	-	148	5,068
A-24	120	2,683	162	-	120	3,988	210	-	304	4,622
A-25	0	3,256	1,793	-	0	4,590	3,013	-	740	8,343
A-26	480	5,653	206	-	1,398	8,274	368	-	505	10,545
A-27	1,340	2,308	12	-	2,200	2,940	12	-	140	5,292
A-28	0	286	1,730	-	0	642	2,449	-	38	3,129
A-29	0	338	1,329	-	0	448	1,710	-	18	2,176
A-30	0	14	323	-	0	17	467	-	6	490
Total	7,083	24,780	11,910	-	12,861	35,010	17,662	-	3,059	68,592

Table 2b.--Sardine eggs, by age categories (age in days), day of spawning and day of collection on Grids I-V.

Date of survey	Station	Age category											
		Spawned April 19 and 20		A Spawned April 18 and 19		B Spawned April 17 and 18		C Spawned April 16 and 17		D Spawned April 15 and 16		Unclassified	n
		Number	Total	Number	Total	Number	Total	Number	Total	Number	Total		
	Grid I												
April 18	GI-1	-	-	0	0	285	417	2,261	3,307	-	-	75	3,799
	GI-2	-	-	3	3	2,264	2,460	2,315	2,411	-	-	0	4,874
	GI-3	-	-	3	3	1,710	1,922	1,444	1,602	-	-	0	3,527
	GI-4	-	-	0	0	1,201	1,372	557	592	-	-	6	1,970
	GI-5	-	-	0	0	1,035	1,124	355	380	-	-	6	1,510
	TI-6	-	-	147	246	1,582	2,368	100	100	-	-	28	2,742
	GI-7	-	-	26	163	576	774	50	61	-	-	18	1,016
	GI-8	-	-	107	356	1,047	1,225	85	99	-	-	16	1,696
	GI-9	-	-	17	374	1,014	1,388	48	53	-	-	45	1,860
	GI-10	-	-	149	698	1,158	1,736	11	11	-	-	49	2,494
	GI-11	-	-	34	118	50	95	14	14	-	-	20	247
	GI-12	-	-	45	138	135	194	3	3	-	-	14	349
	GI-13	-	-	47	127	80	112	0	5	-	-	0	244
	GI-14	-	-	69	212	232	363	0	0	-	-	22	597
	GI-15	-	-	0	8	0	6	0	0	-	-	3	17
	GI-16	-	-	11	14	0	0	0	0	-	-	0	14
	GI-17	-	-	8	16	0	0	0	0	-	-	0	16
	GI-18	-	-	11	28	6	6	0	0	-	-	0	34
April 19	GI-19	0	0	3	3	6	23	0	0	-	-	3	29
	GI-20	0	0	12	23	26	38	0	0	-	-	0	61
	GI-21	0	0	24	36	24	30	0	0	-	-	0	66
	GI-22	0	0	18	18	0	0	0	0	-	-	0	18
	GI-23	0	0	25	31	0	0	0	0	-	-	0	31
	GI-24	0	0	0	0	0	0	0	0	-	-	0	0
	GI-25	0	0	0	0	0	0	0	0	-	-	0	0
Total		0	0	759	2,615	12,431	15,653	7,243	8,638	-	-	305	27,211

Table 2b.--Sardine eggs, by age categories (age in days), day of spawning and day of collection on Grids I-V.--Continued

Date of survey	Station	Age category: Spawned April 20 and 21[1]		A Spawned April 19 and 20		B Spawned April 18 and 19		C Spawned April 17 and 18		D Spawned April 16 and 17		Unclassified	n
		Number	Total	Number	Total	Number	Total	Number	Total	Number	Total		
	Grid II												
April 19	GII-1	-	-	0	0	0	0	12	15	-	-	0	15
	GII-2	-	-	16	16	0	0	928	998	-	-	0	1,014
	GII-3	-	-	10	13	0	0	1,046	1,172	-	-	0	1,185
	GII-4	-	-	21	28	28	31	852	994	-	-	0	1,053
	GII-5	-	-	54	120	88	105	551	632	-	-	2	859
	GII-6	-	-	11	110	210	280	0	0	-	-	0	390
	GII-7	-	-	19	65	418	612	27	30	-	-	19	726
	GII-8	-	-	28	78	1,002	1,111	372	394	-	-	3	1,586
	GII-9	-	-	30	95	108	149	81	105	-	-	20	369
	GII-10	-	-	25	91	32	44	32	35	-	-	9	179
	GII-11	-	-	40	78	125	131	10	14	-	-	0	223
	GII-12	-	-	4	8	62	78	8	12	-	-	0	98
	GII-13	-	-	10	13	3	3	-	0	-	-	0	16
	GII-14	-	-	0	0	3	3	0	0	-	-	0	3
	GII-15	-	-	0	0	0	0	0	0	-	-	0	0
	GII-16	-	-	0	0	0	0	0	0	-	-	0	0
	GII-17	-	-	0	0	0	0	0	0	-	-	0	0
	GII-18	-	-	0	0	0	0	0	0	-	-	0	0
April 20	GII-19	0	0	0	0	47	82	0	0	-	-	9	91
	GII-20	0	0	0	0	20	33	0	0	-	-	0	33
	GII-21	0	0	0	0	9	9	0	0	-	-	0	9
	GII-22	0	0	0	0	3	3	0	0	-	-	0	3
	GII-23	0	0	0	0	0	0	0	0	-	-	0	0
	GII-24	0	0	0	0	0	0	0	0	-	-	0	0
	GII-25	0	0	0	0	0	0	0	0	-	-	0	0
Total		0	0	268	715	2,158	2,674	3,919	4,401	-	-	62	7,852

Table 2b.--Sardine eggs, by age categories (age in days), day of spawning and day of collection on Grids I-V.--Continued

Date of survey	Station	Age category											
		Spawned April 21 and 22[1]		A Spawned April 20 and 21		B Spawned April 19 and 20		C Spawned April 18 and 19		D Spawned April 17 and 18		Unclassified	n
		Number	Total	Number	Total	Number	Total	Number	Total	Number	Total		
	Grid III												
April 20	GIII-1	-	-	0	0	0	3	3	3	-	-	3	9
	GIII-2	-	-	0	0	12	23	9	9	-	-	0	32
	GIII-3	-	-	5	5	350	444	450	613	-	-	42	1,104
	GIII-4	-	-	150	236	57	72	110	114	-	-	0	422
	GIII-5	-	-	51	73	90	99	11	11	-	-	17	200
	GIII-6	-	-	0	0	6	12	0	0	-	-	0	12
	GIII-7	-	-	3	3	9	9	32	41	-	-	0	53
	GIII-8	-	-	23	44	300	457	303	393	-	-	29	923
	GIII-9	-	-	0	3	120	172	104	129	-	-	9	313
	GIII-10	-	-	0	0	62	73	37	62	-	-	0	135
	GIII-11	-	-	30	51	0	6	0	0	-	-	0	57
	GIII-12	-	-	0	0	3	3	0	0	-	-	0	3
	GIII-13	-	-	0	0	0	0	3	3	-	-	0	3
	GIII-14	No sample.											
	GIII-15	-	-	3	6	0	0	0	0	-	-	0	6
	GIII-16	-	-	3	8	14	20	0	0	-	-	8	36
April 21	GIII-17	0	0	0	0	0	0	0	0	-	-	0	0
	GIII-18	0	0	0	0	0	0	0	0	-	-	0	0
	GIII-19	0	0	0	0	0	0	0	0	-	-	0	0
	GIII-20	0	0	0	0	0	0	0	0	-	-	0	0
	GIII-21	0	0	0	0	0	0	0	0	-	-	0	0
	GIII-22	0	0	0	0	0	0	0	0	-	-	0	0
	GIII-23	0	0	0	0	3	3	0	0	-	-	0	3
	GIII-24	15	30	33	45	6	12	0	0	-	-	33	120
	GIII-25	18	110	56	62	426	497	0	0	-	-	47	716
Total		33	140	357	536	1,458	1,905	1,062	1,378	-	-	188	4,147

Table 2b.--Sardine eggs, by age categories (age in days), day of spawning and day of collection on Grids I-V.--Continued

Date of survey	Station	Age category											
		Spawned April 22 and 23[1]		A Spawned April 21 and 22		B Spawned April 20 and 21		C Spawned April 19 and 20		D Spawned April 18 and 19		Unclassified	n
		Number	Total	Number	Total	Number	Total	Number	Total	Number	Total		
	Grid IV												
April 21	GIV-1	-	-	0	0	936	1,229	102	107	-	-	31	1,367
	GIV-2	-	-	2,526	3,266	92	98	29	29	-	-	12	3,405
	GIV-3	-	-	4,590	7,084	7	14	20	20	-	-	34	7,152
	GIV-4	-	-	1,675	3,689	48	54	54	54	-	-	155	3,952
	GIV-5	-	-	919	2,219	507	571	301	301	-	-	79	3,170
	GIV-6	-	-	179	450	13	26	0	0	-	-	124	600
	GIV-7	-	-	268	581	0	0	0	0	-	-	43	624
	GIV-8	-	-	70	235	0	0	0	0	-	-	3	238
	GIV-9	-	-	166	483	0	0	6	6	-	-	125	614
	GIV-10	-	-	765	1,668	92	98	33	33	-	-	0	1,799
	GIV-11	-	-	280	672	7	14	24	27	-	-	68	781
	GIV-12	-	-	65	108	0	0	0	0	-	-	7	115
	GIV-13	-	-	11	11	0	0	0	0	-	-	0	11
	GIV-14	-	-	10	41	0	0	0	0	-	-	3	44
	GIV-15	-	-	105	269	52	60	0	0	-	-	4	333
	GIV-16	-	-	122	195	73	76	11	11	-	-	0	282
April 22	GIV-17	0	0	237	362	28	28	0	0	-	-	10	400
	GIV-18	0	0	48	116	24	34	0	0	-	-	7	157
	GIV-19	0	0	13	16	0	0	0	0	-	-	0	16
	GIV-20	0	0	3	7	0	0	0	0	-	-	0	7
	GIV-21	0	0	16	26	0	0	0	0	-	-	0	26
	GIV-22	3	3	86	120	3	10	0	0	-	-	21	154
	GIV-23	13	13	179	323	35	51	0	0	-	-	32	419
	GIV-24	43	50	116	116	102	132	0	0	-	-	135	433
	GIV-25	90	127	47	107	131	154	0	0	-	-	84	472
Total		149	193	12,496	22,164	2,150	2,649	580	588	-	-	977	26,571

Table 2b.--Sardine eggs, by age categories (age in days,) day of spawning and day of collection on Grids I-V.--Continued

Date of Survey	Station	Age category: Spawned April 23 and 24[1]		A Spawned April 22 and 23		B Spawned April 21 and 22		C Spawned April 20 and 21		D Spawned April 19 and 20		Unclassified	n
		Number	Total	Number	Total	Number	Total	Number	Total	Number	Total		
	Grid V												
April 22	GV-1	-	-	338	416	5,972	6,498	338	416	-	-	188	7,518
	GV-2	-	-	6,598	9,923	3,573	4,424	616	683	-	-	538	15,568
	GV-3	-	-	1,015	1,743	3,198	3,768	570	694	-	-	124	6,329
	GV-4	-	-	399	1,445	1,751	2,329	358	445	-	-	220	4,439
	GV-5	-	-	27	62	442	1,134	151	457	-	-	244	1,897
	GV-6	-	-	2,493	14,111	305	462	23	23	-	-	203	14,799
	GV-7	-	-	4,755	20,587	876	1,277	61	134	-	-	948	22,946
	GV-8	-	-	1,410	5,022	146	207	12	12	-	-	255	5,496
	GV-9	-	-	1,001	10,216	507	581	12	25	-	-	284	11,106
	GV-10	-	-	69	849	426	2,025	3	399	-	-	3,738	7,011
	GV-11	-	-	7,176	15,180	408	516	12	12	-	-	216	15,924
	GV-12	-	-	578	1,496	64	134	0	0	-	-	161	1,791
	GV-13	-	-	18	221	0	21	0	0	-	-	170	412
	GV-14	-	-	217	737	36	99	3	3	-	-	81	920
	GV-15	-	-	204	639	105	249	6	18	-	-	258	1,164
	GV-16	-	-	129	507	75	165	24	45	-	-	69	786
	GV-17	-	-	391	742	172	272	53	61	-	-	90	1,165
April 23	GV-18	0	0	341	468	176	204	0	0	-	-	25	697
	GV-19	0	0	364	491	216	266	0	0	-	-	6	763
	GV-20	3	3	99	225	102	172	0	0	-	-	38	438
	GV-21	0	0	100	218	115	158	0	0	-	-	40	416
	GV-22	0	0	76	124	65	115	0	0	-	-	79	318
	GV-23	0	0	64	122	32	81	0	0	-	-	44	247
	GV-24	3	9	3	18	12	50	0	0	-	-	9	86
	GV-25	0	6	3	12	0	13	0	0	-	-	66	97
Total		6	18	27,868	85,574	18,774	25,220	2,242	3,427	-	-	8,094	122,333

[1] See text page

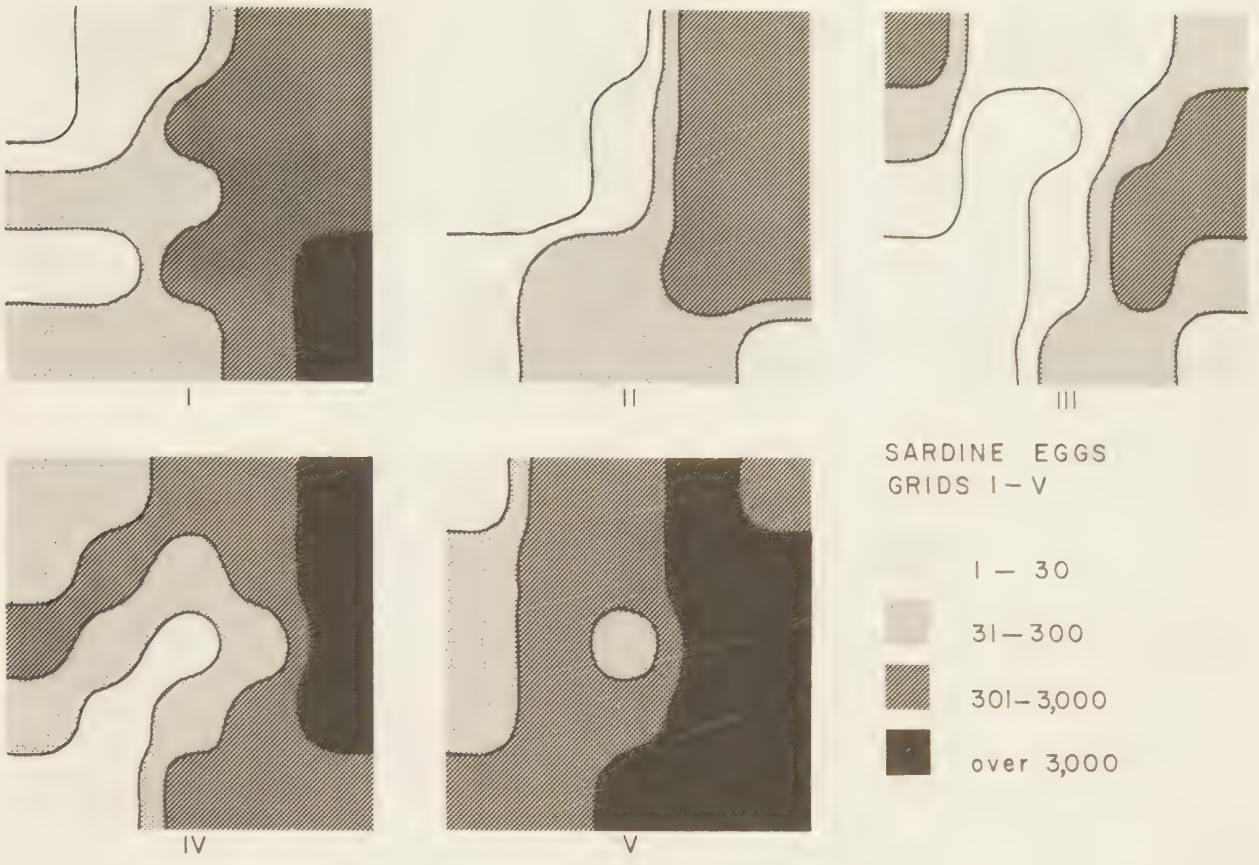

Figure 2. Sardine eggs: distribution and relative abundance on Grids I - V, April 18-23, 1952.

species (anchovy, jack mackerel, Pacific mackerel, hake, and rockfish) were relatively few in numbers (table 3). Tables 4 through 7 are records of all hauls containing larvae of sardine, anchovy, jack mackerel, and Pacific mackerel reported by numbers per size class per station. Tables 8 and 9 are records of all hauls containing hake and rockfish larvae reported by numbers per station.

Noncommercial species of fish larvae (table 3) were best represented by the deep-sea smelt, *Leuroglossus stilbius*, and the lanternfish, *Lampanyctus mexicanus*, which together accounted for about 80 percent of "other fish larvae" collected on the grid, drogue, and anchor stations. These are reported by numbers per station in tables 10 and 11. The distribution diagrams for these larvae on the grids (figs. 4 and 5) show that the greater numbers were usually located offshore. This may indicate one of two types of distribution: First, that each of these species was normally greater in numbers offshore (as the sardine larvae were inshore, fig. 3); or second, that these greater offshore numbers were an indication of diurnal migration of the larvae that made them more available to the net at night, as in the case of other plankton discussed below. The latter seems more probable in view of the findings of Ahlstrom (1959) who reported that these two species showed evidence of diurnal migration in replicate (day and night) vertical distribution series. He found that 5.0 times as many *Leuroglossus stilbius* larvae and 3.6 times as many *Lampanyctus mexicanus* larvae were caught by night as by day.

Differences in day and night collections on the grid stations were determined by weighting the numbers of larvae per haul in the daily collections and finally by 5-day ratios based on larvae per haul for all groups of data; five grids and 5 days each on drogue and anchor stations. Each grid was divided into night

Table 3.--Fish larvae collected at all grid-survey stations.

Larvae	Drogue		Anchor		Grid I		Grid II	
	N	Percent	N	Percent	N	Percent	N	Percent
Sardine	10,199	81.32	12,316	78.75	23,847	82.30	9,944	67.46
Anchovy	28	0.22	48	0.31	113	0.39	113	0.77
Jack mackerel	250	1.99	234	1.50	350	1.21	316	2.14
Pacific mackerel	71	0.57	40	0.26	221	0.76	57	0.39
Hake	128	1.02	283	1.81	323	1.11	256	1.74
Rockfish	49	0.39	191	1.22	110	0.38	138	0.94
Other fish larvae (including: *Leuroglossus stilbius* and *Lampanyctus mexicanus*)	1,817	114.49	2,527	16.16	4,010	13.84	3,916	26.57
Total	12,542	100.00	15,639	100.01	28,974	99.99	14,740	100.01
Leuroglossus stilbius	676	5.39	1,008	6.45	1,577	5.44	1,235	8.38
Lampanyctus mexicanus	842	6.71	1,214	7.76	1,642	5.67	1,954	13.26

Larvae	Grid III		Grid IV		Grid V		Total	Percent of total fish Larvae
	N	Percent	N	Percent	N	Percent		
Sardine	3,937	47.54	1,105	26.09	1,050	29.38	62,398	70.92
Anchovy	74	0.89	61	1.44	18	0.50	455	0.52
Jack mackerel	180	2.17	61	1.44	21	0.59	1,412	1.60
Pacific mackerel	0	0	11	0.26	0	0	400	0.45
Hake	181	2.19	117	2.76	151	4.22	1,439	1.64
Rockfish	102	1.23	106	2.50	42	1.18	738	0.84
Other fish larvae (including: *Leuroglossus stilbius* and *Lampanyctus mexicanus*)	3,908	45.98	2,774	65.50	2,292	64.13	21,144	24.03
Total	8,282	100.00	4,235	99.99	3,574	100.00	87,986	100.00
Leuroglossus stilbius	1,084	13.09	927	21.89	738	20.64	7,245	8.23
Lampanyctus mexicanus	2,121	25.61	1,424	33.62	863	24.15	10,060	11.43

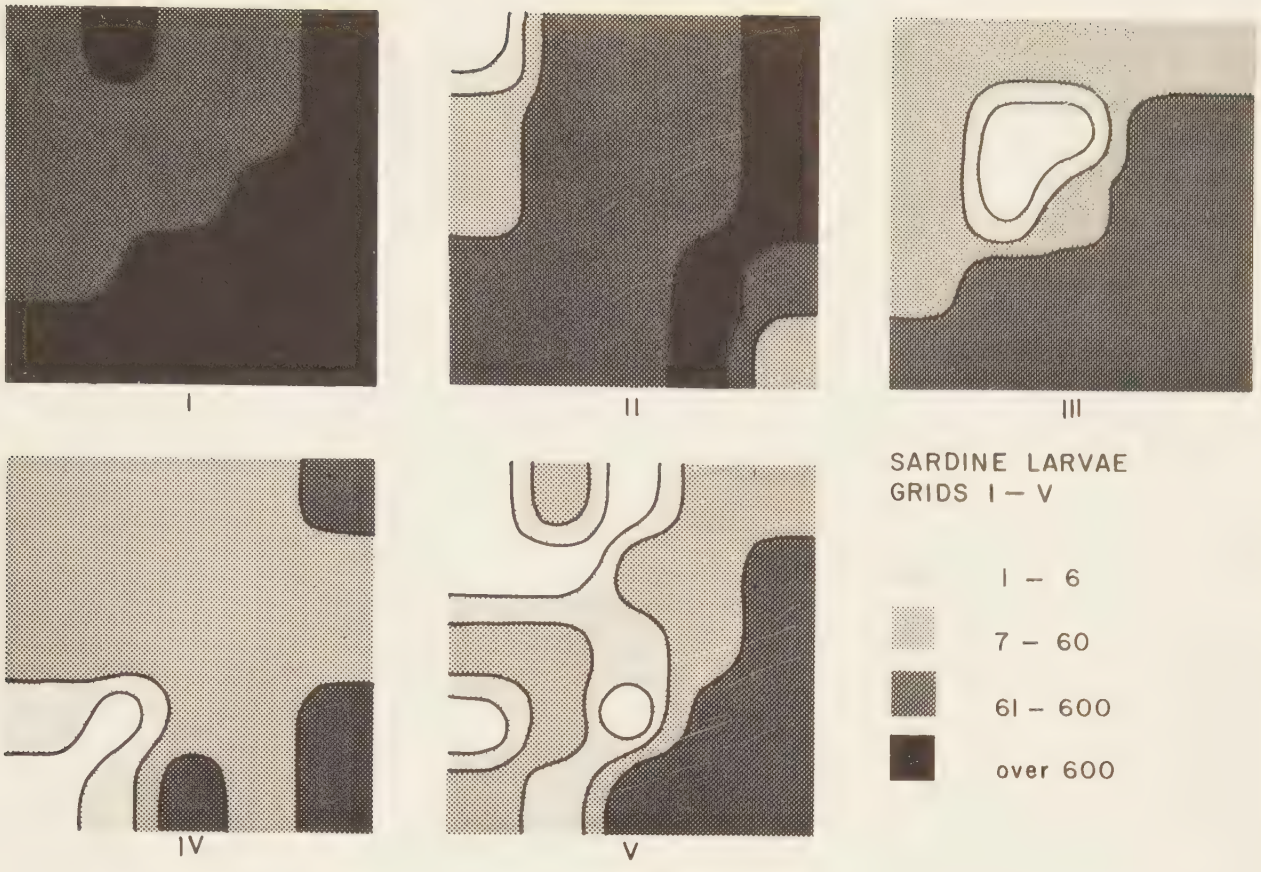

Figure 3. Sardine larvae: distribution and relative abundance on Grids I - V, April 18-23, 1952.

and day stations, omitting the ones occupied at or one-half hour before and after sunset (Ahlstrom, 1954b). Final ratios on the grids showed that 1.88 times as many *Leuroglossus stilbius* larvae and 2.66 times as many *Lampanyctus mexicanus* larvae were collected at night than in the day (table 12). Collections on drogue and anchor stations were either day or night; none were omitted. Five-day ratios of *Leuroglossus stilbius* larvae per haul showed 2.38 and 2.22 times as many collected at night as in the day on the drogue and anchor stations respectively (table 13). The 5-day ratios for *Lampanyctus mexicanus* larvae per haul on the drogue and anchor stations respectively showed 1.82 and 1.44 times as many collected at night as in the day (table 14).

PLANKTON VOLUMES

The plankton volumes reported in table 1 are based on milliters of "wet" plankton per 1,000 cubic meters of water strained. The procedures for measuring plankton were the same as those described in the reports on the annual collections by this laboratory already referred to above.

Relative concentrations of plankton volumes are depicted for the grids by light and heavy shading (fig. 6). The categories of these volumes are: (1) "very light", 33 ml. or less; (2) "light", 33-100 ml.; (3) "moderate", 100-300 ml.; (4) "heavy", 300-900 ml.; and (5) "very heavy", more than 900 ml. Histograms are used to show the plankton volumes of successive samples taken at drogue and anchor stations (fig. 7).

Plankton volumes in the grids were generally in the light category. When very light concentrations occurred they were usually in the eastern half of each day's pattern. Greater concentrations, in moderate to very heavy categories, usually occurred in the western sections. The exception was the fifth day when only two stations showed moderate plankton

Table 4.--Sardine larvae: numbers per size class per station

Station	Midpoint of size class (in mm.)																	Total
	3.0	4.75	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.25	Dis.	
Drogue																			
D-[illegible]		21.6	5.4	2.7															29.7
D-[illegible]	25.7	112.4																	138.1
D-[illegible]	7.8	70.2	33.8		2.6														114.4
D-[illegible]	4.4	87.2	130.8	8.8	6.6														237.8
D-[illegible]	5.9	50.5	14.9																71.3
D-[illegible]	28.8	259.2	69.1	11.5	5.8														374.4
D-[illegible]	52.4	201.4	41.4	2.8															298.0
D-8	34.7	185.8	94.6	6.4	6.3	3.2													331.0
D-[illegible]	19.0	76.2	38.1		2.7														136.0
D-10	32.6	74.0	32.6	20.7	3.0														162.9
D-11	46.7	284.9	79.5	2.7	5.5	2.7													422.0
D-12	No sample																		
D-13	60.4	286.2	31.8	3.2	3.2														384.8
D-14	81.9	246.0	65.6	19.7	6.6	3.3													423.1
D-15	84.6	624.0	256.7	26.0	9.7														1,001.0
D-16	97.5	565.5	529.7	65.0	39.0	26.0	13.0												1,335.7
D-17	90.5	528.5	170.2	32.6	10.9	3.6	7.2	3.6	3.6										850.7
D-18	33.4	607.9	414.1	70.1	43.4		10.0	6.7											1,185.6
D-19	28.0	152.4	99.5	6.2	6.2	3.1	3.1												298.5
D-20	9.1	42.7	27.5			3.0													82.3
D-21	37.6	238.6	72.2	25.1			6.3	3.1											382.9
D-22	21.8	109.2	103.0	25.0	9.4	9.4	3.1	3.1				3.1							287.1
D-23	53.6	46.9	23.4	16.7	10.1	10.1	3.4	3.4	6.8			3.4							177.8
D-24	40.6	115.4	46.8	18.8	15.6	3.1	12.4	12.5	9.3	3.1			3.1						280.7
D-25	3.6	99.4	60.3	14.2	3.6	10.7													191.8
D-26	28.8	25.6		3.2															57.6
D-27	6.3	37.8	34.6	18.8	9.5	12.6													119.6
D-28	4.0	39.6	59.4	59.4	67.3	27.8	39.6	23.7	11.9	7.9		4.0			4.0				348.6
D-29		37.2	18.6	44.1	30.2	20.9	23.2	23.2	9.2	13.9	13.9	6.9		2.3					243.6
D-30		17.2	51.4	65.2	30.9	20.6	10.3	10.3	6.9	10.3	3.4				3.4				229.9
Total	939.7	5,243.5	2,605.0	568.9	328.1	160.1	131.6	89.6	47.7	35.2	17.3	17.4	3.1	2.3	7.4				10,196.9
Anchor																			
A-1	495.3	92.2	28.8	5.8	5.8														627.9
A-2	712.9	162.6	48.4	6.9	10.4		7.0		3.5										951.7
A-3	240.3	237.3	14.6	5.8															498.0
A-4	296.0	290.0	46.9	23.5	2.9	2.9	5.9	5.8											673.9
A-5	399.3	103.0	19.4	16.1	3.2	19.3	3.2	3.2											566.7
A-6	102.3	186.0	18.6	6.2	15.5	15.5	3.1	6.2											353.4
A-7	348.4	1,002.3	45.6	10.7		8.1													1,415.1
A-8	752.2	503.3	2.9	2.9															1,261.3
A-9	461.4	630.6	43.7																1,135.7
A-10	302.1	210.9	42.8	17.1	11.4	5.7													590.0
A-11	243.5	246.5	95.1	8.9	5.9	3.0													602.9
A-12	422.0	363.4	104.7	21.6	6.2														917.9
A-13	158.8	170.6	41.2	11.8	5.9														388.3
A-14	45.9	63.1	28.7	17.2															154.9

Table 4.--Sardine larvae: numbers per size class per station--Continued

Station	Midpoint of size class (in mm.)																	Total
	3.0	4.25	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.25	Dis.	
Anchor																			
A-15	6.3	15.7																	22.0
A-16	3.3	16.3		6.5										3.3					29.4
A-17	38.1	19.1	12.7	6.4	12.7			6.4											95.4
A-18		6.5	6.5											6.5					19.5
A-19	11.4	17.1	17.0																45.5
A-20	11.3	11.3	5.7		5.7														34.0
A-21	35.4	53.0	29.4																117.8
A-22	15.9	15.9	26.5	26.5	15.9														100.7
A-23	19.6	59.0	39.3	49.2	19.7														186.8
A-24	15.7	26.2	136.2	94.3	10.5														282.9
A-25	32.4			5.4															37.8
A-26	168.5		6.2	24.9															199.6
A-27	60.0	8.0	8.0	12.0	8.0														96.0
A-28	139.8	19.1	25.4	44.5	57.2	6.4													292.4
A-29	178.2	3.1		27.6	33.8	6.1													248.8
A-30	118.9	51.0	53.7	76.4	51.0	8.5	2.8	2.8					2.8						367.9
Total	5,835.2	4,583.1	948.0	528.2	281.7	75.5	22.0	24.4	3.5				2.8	9.8					12,314.2
Grid I																			
GI-1	813.3	572.4	15.5	15.5		15.5						2.6							1,434.8
GI-2	411.7	249.9	71.0	28.4	14.2	5.7	2.8												783.7
GI-3	460.5	214.5	42.9	14.3	11.4	5.7	2.9												752.2
GI-4	519.1	780.1	58.0	72.5	14.5		2.9												1,447.1
GI-5	717.9	717.9	77.3	14.3		2.9	2.9												1,533.2
GI-6	102.5	243.7	11.1																357.3
GI-7	66.9	171.6	52.4	5.8	2.9														299.6
GI-8	1,326.2	1,682.3	194.6	32.9															3,236.0
GI-9	1,095.9	564.8	53.4	53.4															1,767.5
GI-10	1,673.1	669.3	154.4	25.7	25.7	25.7					2.9								2,576.8
GI-11	646.8	770.0	58.8	14.0	28.0	16.8	2.8	2.8											1,540.0
GI-12	369.4	344.1	11.3	5.6		2.8		2.8											736.0
GI-13	17.4	151.8	54.8		7.5	2.5	2.5											2.5	239.0
GI-14	17.3	422.4	42.0	7.4	7.4		2.5												499.0
GI-15	105.6	202.9	11.1	8.4	5.6														333.6
GI-16	268.9	368.0	56.6	33.9	22.6		2.8												752.8
GI-17	106.9	219.2	95.9	49.3		11.0										2.7			485.0
GI-18	5.6	132.5	62.0	28.2	14.1	2.8	5.6												250.8
GI-19	22.9	860.9	120.1	34.3	34.3	22.9	11.4			2.9		2.9	2.9						1,115.5
GI-20	46.9	717.8	102.6	26.4	17.6		8.8			2.9		2.9	2.9						928.8
GI-21	272.3	609.8	106.5	65.1	32.5														1,086.2
GI-22	79.6	257.0	21.4	9.2	3.1	3.1	3.1	3.1											379.6
GI-23	38.9	158.5	86.2	30.6	13.9	2.8													330.9
GI-24	11.6	417.6	11.6	23.2		5.8													469.8
GI-25	51.1	261.3	153.4	34.1	11.4														511.3
Total	9,248.3	11,760.3	1,724.9	632.5	266.7	126.0	51.0	8.7		5.8	2.9	8.4	5.8			2.7		2.5	23,846.5

Table 4.--Sardine larvae: numbers per size class per station--Continued

Station	Midpoint of size class (in mm.)																	Total
	3.0	4.75	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.25	Dis.	
Grid II																			
GII-1	17.8	20.7	5.9	14.8	3.0	3.0	3.0												68.2
GII-2	409.5	179.4	7.8																596.7
GII-3	389.7	1,861.5	146.6	46.6															2,444.4
GII-4	196.7	410.6	44.9	13.8		3.4													669.4
GII-5	131.8	429.4	43.9	4.8															609.9
GII-6	29.5	69.9	25.7		3.7														128.8
GII-7	19.0	239.4	87.4	11.4															357.2
GII-8	137.8	347.4	40.6	6.2	3.1														535.1
GII-9	246.7	513.8	77.7	16.9		3.4													858.5
GII-10	500.9	670.9	22.1	15.8	6.3	6.4													1,222.4
GII-11	57.2	384.2	104.5	6.8	3.4	3.4		3.4											562.9
GII-12	39.0	144.3	11.7	3.9	7.8	3.9													210.6
GII-13	6.4	121.3	60.7	6.4	3.2														198.0
GII-14	13.2	29.7	49.5	19.3	6.6		3.3												121.6
GII-15	6.9	62.3	10.4																79.6
GII-16	3.4	51.8	3.4	3.4															62.0
GII-17	13.2	66.0	9.9	9.9															99.0
GII-18		77.0	61.6	27.0	3.8														169.4
GII-19	12.6	106.8	53.4	34.6	22.0														229.4
GII-20	16.3	104.3	35.9	16.3	6.5	3.3				3.3									185.9
GII-21	77.8	110.6	24.0	18.0	6.0	3.0	3.0	3.0											245.4
GII-22	6.4	51.5	96.6	19.3	9.6	9.6	3.2												196.2
GII-23	3.4	41.1	10.2	3.4															58.1
GII-24	3.4	20.4	10.2	3.4															37.4
GII-25																			
Total	2,338.6	6,114.3	1,044.6	302.0	85.0	39.4	12.5	6.4		3.3									9,946.1
Grid III																			
GIII-1	375.3	534.6	13.5	8.1	2.7														934.2
GIII-2	145.8	111.5	22.9	5.8															286.0
GIII-3	347.1	136.8	18.5	2.6		2.6													507.6
GIII-4	30.0	29.9	6.0																65.9
GIII-5	11.3	25.4		2.8															39.5
GIII-6		11.8	2.9																14.7
GIII-7	8.7	26.1	29.0	2.9		2.9													69.6
GIII-8	52.4	35.0	26.2		2.9				2.9										119.4
GIII-9	251.8	153.5	3.1																408.4
GIII-10	188.9	169.2	17.0	2.8															377.9
GIII-11	152.6	98.7	74.8	15.0	3.0		3.0												347.1
GIII-12	68.9	80.4	43.1	11.4	8.6	2.9													215.3
GIII-13	8.7	17.4	17.4	5.8															49.3
GIII-14	No sample																		
GIII-15	2.8	33.2	8.3	2.8	5.5														52.6
GIII-16	5.6	5.6		2.8															14.0
GIII-17																			
GIII-18																			
GIII-19		43.5	14.5	14.5	5.8		2.9												81.2

Table 4.--Sardine larvae: numbers per size class per station--Continued

Station	Midpoint of size class (in mm.)																	Total
	3.0	4.75	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.25	Dis.	
Grid III																			
GIII-20	11.7	32.3	26.4	29.4	20.6	5.9	5.8												132.1
GIII-21		69.0	13.8	8.3	8.3	2.8													102.2
GIII-22		14.3	2.9	2.9		2.9								2.9		2.9			28.8
GIII-23		47.3	3.0	6.0															56.3
GIII-24		3.0	3.0		12.0	3.0													21.0
GIII-25		3.0		5.9	3.0														11.9
Total	1,661.6	1,681.5	346.3	129.8	72.4	23.0	11.7		2.9					2.9		2.9			3,935.0
Grid IV																			
GIV-1	35.8	68.8	25.5	7.7															137.8
GIV-2	17.4	40.5	17.3		5.8														81.0
GIV-3	6.8	13.6	6.8																27.2
GIV-4	12.0		29.8	6.0															47.8
GIV-5	19.0	19.0	69.8	53.9	6.4	3.2													171.3
GIV-6	3.2	25.5	22.4	3.2														3.2	57.5
GIV-7	6.1	21.3	18.2	3.0															48.6
GIV-8	6.8	10.1		13.5															30.4
GIV-9	9.6	9.6	3.2																22.4
GI7-10	26.2	26.2	6.5																58.9
GIV-11	68.2	98.9	17.0	10.2	10.2														204.5
GIV-12	18.0	10.8	10.8	10.8															50.4
GIV-13	3.5	17.7																	21.2
GIV-14		6.8			3.4		3.4												13.6
GIV-15	11.2																		11.2
GIV-16	22.9	11.5		3.8															38.2
GIV-17	17.4		3.5																20.9
GIV-18	3.4			3.4		3.4													10.2
GIV-19																			
GIV-20	3.3																		3.3
GIV-21																			
GIV-22	3.4																		3.4
GIV-23			3.2	6.4															9.6
GIV-24		3.3					3.3												6.6
GIV-25	3.4		16.8	10.1															30.3
Total	297.6	383.6	250.8	132.0	25.8	6.6	6.7											3.2	1,106.3
Grid V																			
GV-1	60.9	38.8	16.6		16.6														132.9
GV-2	44.8		22.4		22.4														89.6
GV-3	56.4	16.9			5.6														78.9
GV-4	23.1	23.1	5.8	17.4	11.6														81.0
GV-5	35.6	8.9			5.9	3.0													53.4
GV-6	33.9		11.3																45.2
GV-7	12.2	24.3	12.2																48.7
GV-8		12.2																	12.2
GV-9	55.7	6.2	24.7	12.4	6.2														105.2

Table 4.--Sardine larvae: numbers per size class per station--Continued

Station	Midpoint of size class (in mm.)																	
	3.0	4.75	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	[illegible]	[illegible]	23.25	[illegible]	[illegible]
Grid V																			
GV-10	99.0	12.0	6.0	6.0															123.0
GV-11		12.0	96.0	24.0															132.0
GV-12																			
GV-13	6.0																		6.0
GV-14	6.0	3.0																	9.0
GV-15																			
GV-16	21.0		3.0			6.0		3.0											33.0
GV-17																			
GV-18	5.5	16.6			2.8														24.9
GV-19	8.9	17.8	3.0																29.7
GV-20						2.9													2.9
GV-21	2.9			2.9	14.3														20.1
GV-22																			
GV-23	11.6	5.8																	17.4
GV-24																			
GV-25																			
Total	474.5	197.6	201.0	62.7	85.4	11.9		3.0											1,036.1

TABLE 5.--Anchovy: numbers per size class per station

Station	Mid-Point of size class (in mm.)																		
	2.5	3.75	4.75	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.25	Dis.	Total
Drogue																				
D-11			2.7	2.7				2.7											2.7	10.8
D-12	No sample																			
[illegible]										3.3										3.3
D-19								3.1												3.1
D-27				3.2																3.2
D-28								4.0	4.0											8.0
Total			2.7	5.9				9.8	4.0	3.3									2.7	28.4
Anchor																				
A-4						2.9								2.9						5.8
A-5					3.2															3.2
A-6							3.1													3.1
A-7									2.7											2.7
A-11													3.0							3.0
A-12								3.1	3.1											6.2
A-16					6.5				6.5											13.0
A-24															5.2					5.2
A-30			2.8						2.8											5.6
Total			2.8		9.7	2.9	3.1	3.1	15.1				3.0	2.9	5.2					47.8
Grid I																				
GI-2					2.8															2.8
GI-17						2.7	8.2	2.7	2.7	2.7	2.7		2.7							24.4
GI-18							2.8		2.8											5.6
GI-20							2.9		2.9											5.8
GI-21		3.0	3.0			3.0														9.0
GI-22						9.2	6.1	3.1	3.1							6.2				27.7
GI-23			8.3	5.6		5.6	2.8													22.3
GI-24								5.8												5.8
GI-25					2.8			2.8			2.8									8.4
Total		3.0	11.3	5.6	5.6	20.5	22.8	14.4	11.5	2.7	5.5		2.7			6.2				111.8
Grid II																				
GII-1								6.0												6.0
GII-6					3.7															3.7
GII-11				3.4																3.4
GII-15							3.5	3.5	3.5			3.5								14.0
GII-16								3.5	3.5											7.0
GII-17								3.3												3.3
GII-18			3.9	3.9	3.9		3.9													15.6
GII-19					3.1			3.1		3.1										9.3
GII-20															3.3					3.3
GII-21							3.0				3.0				3.0					9.0
GII-22			3.2	3.2	6.4	3.2		3.2	3.2											22.4
GII-24		3.4						10.2												13.6
Total		3.4	7.1	10.5	17.1	3.2	10.4	32.8	10.2	3.1	3.0	3.5			6.3					110.6

TABLE 5.--Anchovy: numbers per size class per station--Continued

Station	Mid-point of size class (in mm.)																		
	2.5	3.75	4.75	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.25	Dis	Total
Grid III																				
GIII-9									3.1											3.1
GIII-11				3.0																3.0
GIII-14	No sample																			
GIII-16		5.6	5.6		2.8															14.0
GIII-17											2.8				2.3	2.8		2.3		11.2
GIII-20					2.9	2.9														5.8
GIII-21												2.3								2.3
GIII-22						2.9									2.9					5.8
GIII-23						6.0		3.0				3.0			3.0					15.0
GIII-24			3.0	3.0		12.0	3.0													21.0
GIII-25							3.0		3.0						3.0		3.0			12.0
Total		5.6	8.6	6.0	5.7	23.8	6.0	3.0	6.1		2.8	5.8			11.7	2.8	3.0	2.8		93.7
Grid IV																				
GIV-2		2.9																		2.9
GIV-4									3.0											3.0
GIV-11								3.4												3.4
GIV-15						3.7													3.7	7.4
GIV-16						3.8	3.8	3.8												11.4
GIV-17								3.5												3.5
GIV-18										3.4										3.4
GIV-19											3.3									3.3
GIV-22							3.4													3.4
GIV-23								3.2		3.2										6.4
GIV-24						6.6														6.6
Total		2.9				14.1	7.2	13.9	3.0	6.6	3.3								3.7	54.7
Grid V																				
GV-4											5.8									5.8
GV-19								3.0												3.0
GV-22					2.9				2.9											5.8
GV-24						2.9														2.9
Total					2.9	2.9		3.0	2.9		5.8									17.5

TABLE 6.--Jack mackerel larvae: numbers per size class per station

Station	Mid-point of size class (in mm.)																						Total
	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.25	Dis.	
Drogue																								
D-1							21.6	5.4	2.7															29.7
D-2	3.2																							3.2
D-3	2.6																							2.6
D-4	4.4	6.5	2.2																					13.1
D-5	3.0																							3.0
D-7	8.3		2.8																					11.1
D-8			3.2																					3.2
D-10		3.0	3.0																					6.0
D-11	2.7	2.7	2.7																					8.1
D-12	No sample																							
D-13			3.2																					3.2
D-14	3.2		12.7																					15.9
D-15	6.5	3.2																						9.7
D-16		3.2	9.8																					13.0
D-17	3.6	3.6	3.6	3.6																				14.4
D-18		3.3	20.0	13.4	3.3	3.3																		43.3
D-19			12.4	3.1																				15.5
D-21		6.3	3.1				3.1																	12.5
D-22			3.1																					3.1
D-23		3.4	6.7																					10.1
D-24				6.2	3.1																			9.3
D-25				7.1																				7.1
D-26		6.4																						6.4
D-27		9.4	3.2	3.2																				15.8
D-28		4.0	15.8																					19.8
D-29		2.3																						2.3
D-30			3.4																					3.4
Total	37.5	57.3	110.9	36.6	6.4	3.3	24.7	5.4	2.7															284.8
Anchor																								
A-6	3.1	3.1		3.1																				9.3
A-7	40.2	8.0																						48.2
A-8	31.5	5.7																						37.2
A-9	13.6	27.3	13.6																					54.5
A-10	5.7	2.8																						8.5
A-11	5.9	8.9																						14.8
A-12	3.1	9.2																						12.3
A-14			5.7																					5.7
A-20	11.3	5.7																						17.0
A-21	5.9																							5.9
A-27	8.0																							8.0
A-28	12.7																							12.7
Total	141.0	70.7	19.3	3.1																				234.1
Grid I																								
GI-4	5.8				2.9																			8.7
GI-5	8.6	2.9	5.7																					17.2

TABLE 6.--Jack mackerel larvae: numbers per size class per station--Continued

Station	Mid-point of size class (in mm.)																						Total
	2.5	2.5	3.0	3.5	4.0	4.5	5.0	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.5	Over	
Grid I																								
GI-6	[illegible]	5.5																						[illegible]
GI-7	[illegible]	2.9	[illegible]																					[illegible]
GI-8	[illegible]	11.0	[illegible]																					[illegible]
GI-9	[illegible]	2.8			5.6																			[illegible]
GI-10		2.9	[illegible]																					[illegible]
GI-11	[illegible]	11.2			8.4																			[illegible]
GI-13	[illegible]	5.0	[illegible]																					[illegible]
GI-14	[illegible]	2.5																						[illegible]
GI-16	[illegible]	8.5																						[illegible]
GI-17	[illegible]	16.4																						[illegible]
GI-19		5.7	2.9																					[illegible]
GI-20		5.9	2.9																					[illegible]
GI-21	3.0	14.8	3.0																					[illegible]
GI-22		21.4	24.5																					[illegible]
GI-23	[illegible]	16.7	22.2	5.6																				[illegible]
GI-25	[illegible]																							[illegible]
Total	[illegible]	136.1	80.4	5.6	16.9																			[illegible]
Grid II																								
GII-2	3.9																							3.9
GII-3	20.0	3.3	3.3	3.3																				29.9
GII-4	[illegible]																							[illegible]
GII-5	[illegible]	14.6																						[illegible]
GII-6	3.7	11.0																						14.7
GII-7	3.8	11.4	3.8																					19.0
GII-8		6.3																						6.3
GII-9	3.4	23.7	33.8	6.8																				67.7
GII-10	12.6	9.4			3.2																			25.2
GII-11	6.7	10.1	27.0																					43.8
GII-12			3.9																					3.9
GII-13		9.4	6.3																					15.7
GII-14		3.3	3.3																					6.6
GII-15		3.5																						3.5
GII-16	3.4																							3.4
GII-19	3.1	6.3																						9.4
GII-21	3.0	9.0																						12.0
GII-22	3.2		6.4																					9.6
GII-23	3.4	6.8																						10.2
GII-24			3.4																					3.4
Total	[illegible]	128.1	91.2	10.1	3.2																			314.6
Grid III																								
GIII-1	10.8	10.8	5.4																					27.0
GIII-2		2.9																						2.9
GIII-3	5.3	18.4	2.6																					26.3
GIII-4	3.0	6.0																						9.0
GIII-5		2.8																						2.8

TABLE 6.--Jack mackerel larvae: numbers per size class per station--Continued

Station	Mid-Point of size class (in mm.)																						Total
	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.25	Dis.	
Grid III																								
GIII-6		2.9																						2.9
GIII-7		2.9																						2.9
GIII-8	2.9	2.9																						5.8
GIII-9		3.1																						3.1
GIII-10		2.8	2.8																					5.6
GIII-11	9.0	12.0																						21.0
GIII-12	8.6	8.6																						17.2
GIII-13	5.8	5.8	2.9																					14.5
GIII-14	No sample																							
GIII-15		2.8																						2.8
GIII-19			5.8	5.8																				11.6
GIII-20		2.9	14.7																					17.6
GIII-21	2.8		2.8																					5.6
Total	48.2	87.6	37.0	5.8																				178.6
Grid IV																								
GIV-1			7.6																					7.6
GIV-5	12.7		3.2																					15.9
GIV-9			3.2																					3.2
GIV-11		3.1	12.6																					15.7
GIV-12		3.6							3.6															7.2
GIV-13	3.5	3.5																						7.0
GIV-25		3.4																						3.4
Total	16.2	13.6	26.6						3.6															60.0
Grid V																								
GV-3		5.6																						5.6
GV-14	3.0																							3.0
GV-15	3.0														3.0									6.0
GV-18			2.8																					2.8
GV-22		2.9																						2.9
Total	6.0	8.5	2.8												3.0									20.3

Table 7.--Pacific mackerel larvae: numbers per size class per station.

Station	Mid-point of size class (in mm.)																						Total
	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.25	Dis.	
Drogue																								
D-11			2.7																					2.7
D-12	No sample.																							
D-16				3.2																				3.2
D-17			3.6																					3.6
D-18			3.3	3.3																				6.6
D-19		3.1	12.4																					15.5
D-21			9.4	3.1																				12.5
D-22	3.1		6.2																					9.3
D-23		3.4																						3.4
[illegible]			7.9																					[illegible]
D-29			2.3																					2.3
[illegible]			3.4																					3.4
Total	3.1	6.5	51.2	9.6																				70.4
Anchor																								
[illegible]	[illegible]		[illegible]																					
A-6								3.1																3.1
A-7			2.7	5.4																				8.1
[illegible]		[illegible]	[illegible]																					[illegible]
A-9			2.7																					2.7
A-20				5.7																				5.7
[illegible]	[illegible]	[illegible]																						[illegible]
Total	6.0	8.6	11.5	11.1				3.1																40.3
Grid I																								
GI-2			5.7	11.4	5.7																			22.8
GI-4			2.9	11.6	2.9																			17.4
GI-5			2.9	5.7	5.7																			14.3
GI-7			14.6																					14.6
[illegible]			[illegible]	[illegible]																				21.9
GI-9		2.8	14.0	19.6																				36.4
GI-10			11.4	8.6																				20.0
GI-11		2.8	5.6	8.4	5.6																			22.4
GI-12	2.8	2.8	5.6	2.8	2.8																			16.8
GI-13			2.5	2.5																				5.0
GI-19			8.6																					8.6
GI-23			5.6																					5.6
GI-24			11.6																					11.6
GI-25			2.8																					2.8
Total	2.8	8.4	110.2	76.1	22.7																			220.2

Table 7.--Pacific mackerel larvae: numbers per size class per station.--Continued

Station	Mid-point of size class (in mm.)																						Total
	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.75	6.75	7.75	8.75	9.75	10.75	11.75	12.75	13.75	14.75	15.75	17.25	19.25	21.25	23.25	Dis.	
Grid II																								
GII-3			10.0	6.7	3.3																			20.0
GII-5			4.9																					4.9
GII-8				3.1																				3.1
GII-10			6.3		3.2	3.2		3.2																15.9
GII-11				3.4	3.4			3.4																10.2
GII-21			3.0																					3.0
Total			24.2	13.2	9.9	3.2		6.6																57.1
Grid IV																								
GIV-1			5.1																					5.1
GIV-2		5.8																						5.8
Total		5.8	5.1																					10.9

Table 8.--Hake larvae, number per station

Station	Drogue	Anchor	Grid I	Grid II	Grid III	Grid IV	Grid V
1			10	3	5		11
2	3	7	28	4	6	12	
3	3	6	26	16	13	7	
4	2	12	9	7	21		
5		6	6	5	20	19	3
6	3	6		4	3	3	
7		13	3	8			12
8	13	14	25	12	3		12
9	3	11	11	7	12	3	12
10		3	43	25		17	15
11		24	20	30	21	14	36
12	NS[1]	15	11		17	11	6
13	6	12	2	6	12		6
14	3	6		3	NS[1]		6
15	6		8				
16		6	3	3		8	
17	7		6	7	3	7	
18	3	13	3				
19	12	23	14	25	6	3	
20	3	17	3	10	24	10	32
21	3	18	44	30	6		3
22		21	34	45	3		
23	3		11	3	3	3	3
24	3	5		3	3		
25	14	16	3				
26	22	6	-	-	-	-	-
27		4	-	-	-	-	-
29		13	-	-	-	-	-
29	9		-	-	-	-	-
30	7	6	-	-	-	-	-
Total	128	283	323	256	181	117	151

[1] No sample

Table 9.--Rockfish larvae, number per station

Station	Drogue	Anchor	Grid I	Grid II	Grid III	Grid IV	Grid V
1	3	14		36	27	15	
2		21	11	20		35	
3		18	29	7			6
4		26	9	7		6	
5	3	19	3	2	6		
6		6	3	4	3	16	
7				8	3	6	12
8		3			9		
9		6		3	3		
10	3			3	3		
11				7		7	
12	NS[1]			12	12		3
13	3				6	4	
14			5		NS[1]		
15	6	3			3		3
16	3	6	6	7	6	8	
17			6	10	3		3
18	3	6	3		3	3	6
19		6	3				6
20			23				
21	3		3	3	6		3
22	3			3	6		
23			3			3	
24				3		3	
25	7	16	3	3	3		
26			-	-	-	-	-
27	9		-	-	-	-	-
28		32	-	-	-	-	-
29		9	-	-	-	-	-
30	3		-	-	-	-	-
Total	49	191	110	138	102	106	42

[1] No sample

Table 10.--*Leuroglossus stilbius* larvae, number per station

Station	Drogue	Anchor	Grid I	Grid II	Grid III	Grid IV	Grid V
1		35	44	18	24	10	33
2	3	35	48	20	17	81	11
3	10	20	46	47	45	14	
4	15	38	110	38	54	12	
5	12	58	69	17	45	13	6
6	37	25	6	52	6	13	45
7	22	27	3	23	3	9	61
8	16	26	66	41	12	47	61
9	5	41	34		31	6	37
10	18	26	157	82	25	72	15
11	16	54	64	17	75	55	12
12	NS[1]	77	31	12	46	18	27
13	10	6	2	29	14	39	24
14	16	34	5	16	NS[1]	41	24
15	6	3	6	42	61	49	18
16	42	46	91	83	65	15	54
17	43	44	115	59	78	31	23
18	53	39	34	142	112	54	11
19		17	49	22	58	68	62
20	3	23	117	23	41	56	56
21	44	12	172	179	39	45	43
22	25	85	70	55	60	51	44
23	13	39	131	82	86	35	29
24	22	42	64	115	66	56	29
25	14	11	43	21	21	37	13
26	13	19	-	-	-	-	-
27	44	4	-	-	-	-	-
28	103	38	-	-	-	-	-
29	30	40	-	-	-	-	-
30	41	45	-	-	-	-	-
Total	676	1009	1577	1235	1084	927	738

[1] No sample

Table 11.--*Lampanyctus mexicanus* larvae, numbers per station

Station	Drogue	Anchor	Grid I	Grid II	Grid III	Grid IV	Grid V
1	22	3	28	18	32	31	33
2	10	14	34	12	26	76	11
3	70	18	23	37	97	61	23
4	26	20	38	21	120		6
5	24	13	52	32	116	19	6
6	37	12	6	63	38	10	
7	11	35	3	19	84	21	36
8	16	32	44	28	64	40	24
9	8	30	42		74	48	93
10	15	23	60	9	40	65	36
11	16	71	56	40	84	44	96
12	NS[1]	52	28	12	60	47	
13	6	53	10	38	38	64	
14	13	103	15	23	NS[1]	55	
15	20	9	31	118	28	49	
16	20	62	85	66	73	23	57
17	36	44	110	287	109	45	29
18	33	117	132	212	98	41	14
19		74	114	75	191	94	41
20		74	70	26	115	100	15
21	16	18	157	87	88	100	54
22	28	80	150	148	92	62	62
23	74	39	231	178	314	58	82
24	69	131	75	295	134	145	120
25	28	-	48	110	6	127	25
26	32	31	-	-	-	-	-
27	50	4	-	-	-	-	-
28	79	13	-	-	-	-	-
29	42	18	-	-	-	-	-
30	41	20	-	-	-	-	-
Total	842	1213	1642	1954	2121	1425	863

[1] No sample

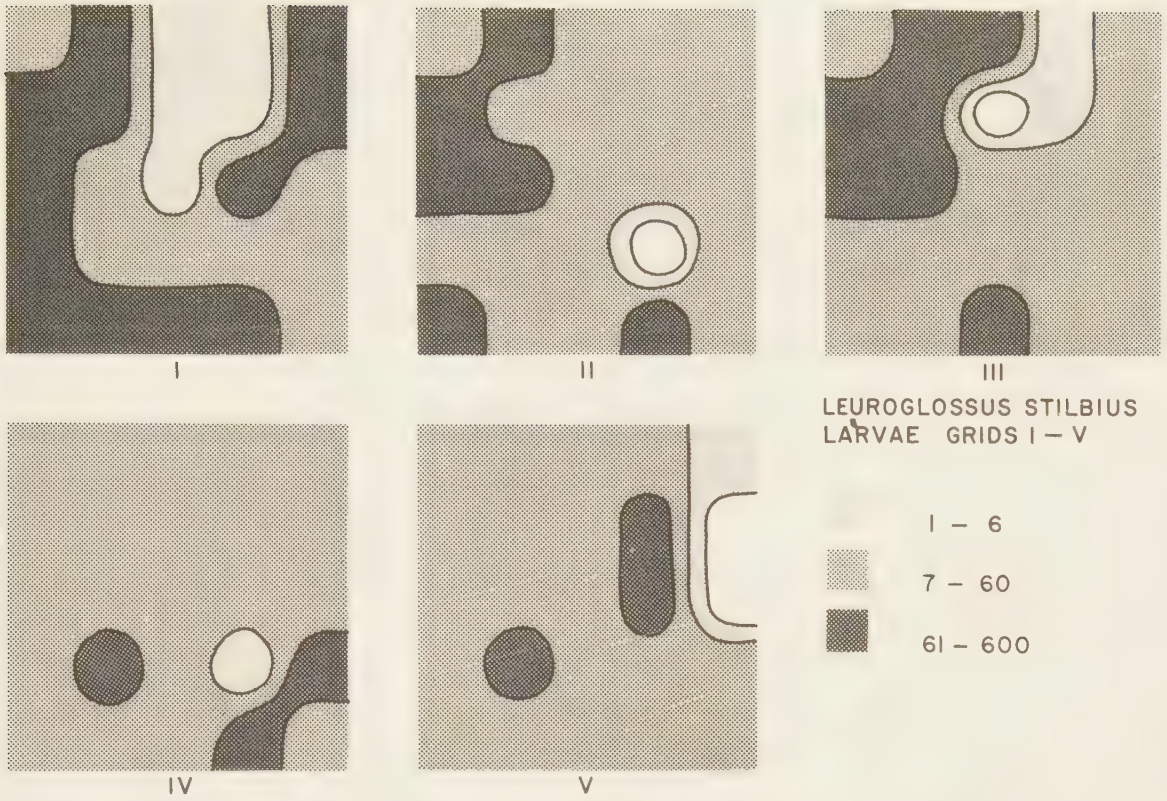

Figure 4. *Leuroglossus stilbius* larvae: distribution and relative abundance on Grids I - V, April 18-23, 1952.

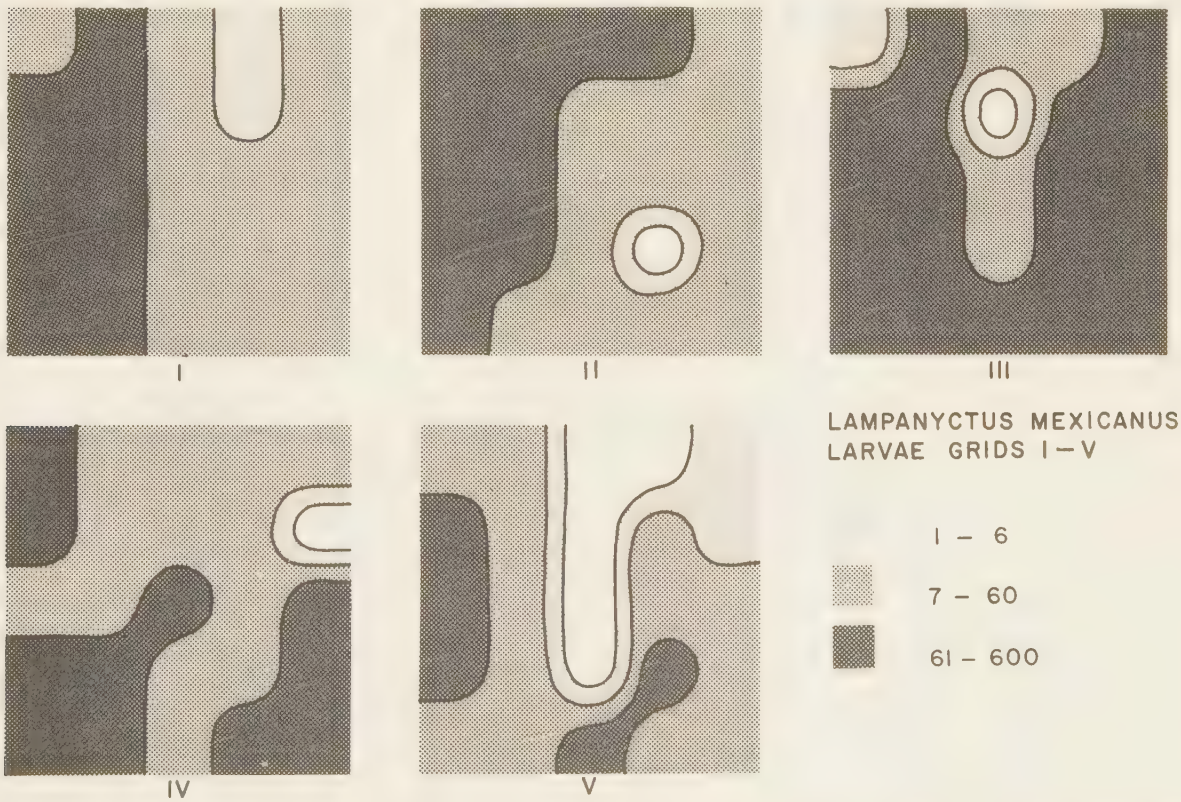

Figure 5. *Lampanyctus mexicanus* larvae: distribution and relative abundance on Grids I - V, April 18-23, 1952.

TABLE 12--Night (N) and day (D) collections of larvae of *Leuroglossus stilbius*[1] and *Lampanyctus mexicanus*[2] on grids I - V.

Grid	Time	Stations[3]	*Leuroglossus stilbius*			*Lampanyctus mexicanus*		
			Total larvae	Number per haul	Grid ratio[4] Night/day	Total larvae	Number per haul	Grid ratio[4] Night/day
I	D: 0810 - 1740	1 - 15	691	46.07	1.91	470	31.23	3.87
	N: 1905 - 0050	17 - 25	795	88.03		1,087	120.78	
II	D: 0810 - 1715	1 - 13	396	30.46	2.46	329	25.31	5.75
	N: 1900 - 0240	15 - 25	823	74.81		1,602	145.64	
III	D: 0810 - 1710	1 - 13	397	30.54	2.04	873	67.15	1.69
	N: 1845 - 0250	15 - 25	687	62.45		1,248	113.45	
IV	D: 0810 - 1735	1 - 13	389	29.92	1.51	526	40.46	1.90
	N: 1915 - 0240	15 - 25	497	45.18		844	76.73	
V	D: 0810 - 1720	1 - 14	356	25.43	1.35	364	26.00	1.89
	N: 1925 - 0100	17 - 25	310	34.44		442	49.11	
5-day ratio of larvae per haul Night/Day:					1.88			2.66

[1] See table 13
[2] See table 14
[3] Stations omitted if taken at or within one-half hour before and after sunset
[4] Based on number of larvae per haul

TABLE 13.--Night and day collections of *Leuroglosus stilbius* larvae on drogue and anchor stations[1]

Day	Drogue stations							Anchor stations						
	Day hauls (D)			Night hauls (N)			Daily ratio[2] (N/D)	Day hauls (D)			Night hauls (N)			
	Station	Number per haul	Average number per haul	Station	Number per haul	Average number per haul		Station	Number per haul	Average number per haul	Station	Number per haul	Average number per haul	Daily ratio[2] (N/D)
1	1			4	15			1	35		4	38		
	2	3		5	12			2	35		5	58		
	3	10		6	37			3	20		6	25		
			4.33			21.33	4.93			30.00			40.33	1.34
2	7	22		10	18			7	27		10	26		
	8	16		11	16			8	26		11	54		
	9	5		12	NS[3]			9	41		12	77		
			14.33			17.00	1.19			31.33			52.33	1.67
3	13	10		16	42			13	6		16	46		
	14	16		17	43			14	34		17	44		
	15	6		18	53			15	3		18	39		
			10.67			46.00	4.31			14.33			43.00	3.00
4	19			22	25			19	17		22	85		
	20	3		23	13			20	23		23	39		
	21	44		24	22			21	12		24	42		
			15.67			20.00	1.28			17.33			55.33	3.19
5	25	14		28	103			25	11		28	38		
	26	13		29	30			26	19		29	40		
	27	44		30	41			27	4		30	45		
			23.33			58.00	2.49			11.33			41.00	3.62
Total		206			470				313			606		
	5-day ratio of larvae per haul N/D: Drogue - 2.38 Anchor - 2.22													

[1] See table 12
[2] Larvae per haul
[3] NS - No sample

TABLE 14.--Night and day collections of *Lampanyctus mexicanus* larvae on drogue and anchor stations[1]

Day	Drogue stations							Anchor stations						
	Day hauls (D)			Night hauls (N)			Daily ratio[2] (N/D)	Day hauls (D)			Night hauls (N)			
	Station	Number per haul	Average number per haul	Station	Number per haul	Average number per haul		Station	Number per haul	Average number per haul	Station	Number per haul	Average number per haul	Daily ratio[2] (N/D)
1	1	22		4	26			1	3		4	20		
	2	10		5	24			2	14		5	13		
	3	70		6	37			3	18		6	12		
			34.00			29.00	0.85			11.67			15.00	1.29
2	7	11		10	15			7	35		10	23		
	8	16		11	16			8	32		11	71		
	9	8		12	NS[3]			9	30		12	52		
			11.67			15.50	1.33			32.33			48.67	1.51
3	13	6		16	20			13	53		16	62		
	14	13		17	36			14	103		17	44		
	15	20		18	33			15	9		18	117		
			13.00			29.67	2.28			55.00			74.33	1.35
4	19			22	28			19	74		22	80		
	20			23	74			20	74		23	39		
	21	16		24	69			21	18		24	131		
			5.33			57.00	10.69			55.33			83.33	1.51
5	25	28		28	79			25			28	13		
	26	32		29	42			26	31		29	18		
	27	50		30	41			27	4		30	20		
			37.67			54.00	1.43			11.66			17.00	1.46
Total		302			540				498			715		

5-day ratio of larvae per haul N/D: Drogue - 1.82
Anchor - 1.44

[1] See table 12
[2] Based on average number per haul
[3] NS - No sample

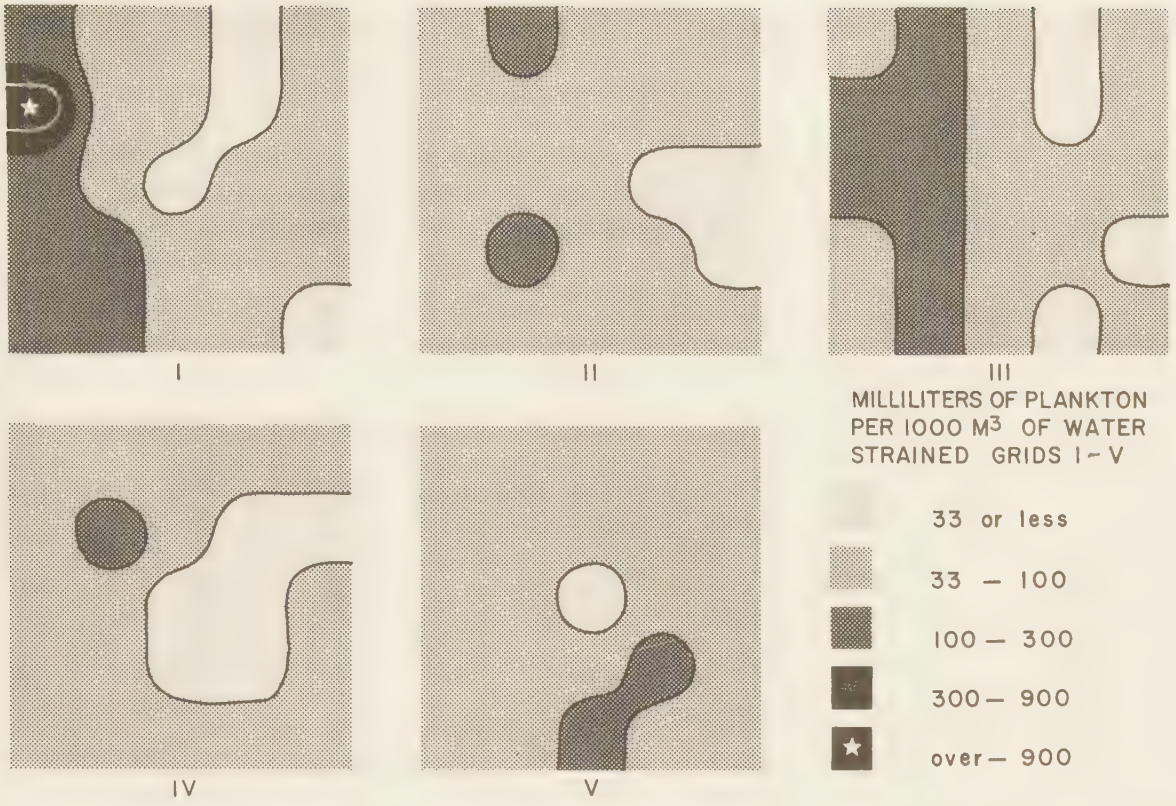

Figure 6. Plankton volumes: relative concentrations on Grids I-V, April 18-23, 1952.

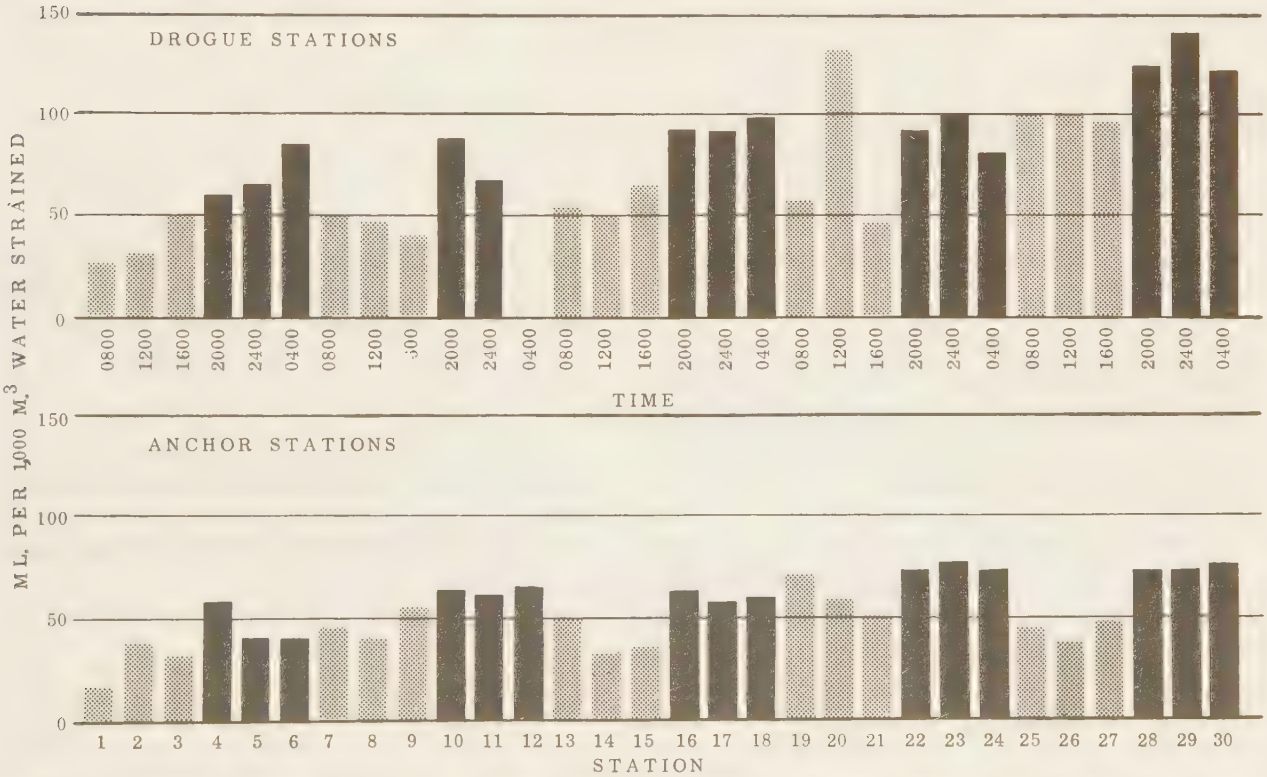

Figure 7. Plankton volumes (ml./1,000 m.^{3} water strained) on drogue and anchor stations, April 18-23, 1952. Times are idealized to the 4-hour intervals discussed in the text. (See table 1 for actual times).

TABLE 15.--Night (N) and day (D) collections of plankton volumes[1] on Grids I-V.

Grid	Time	Stations[2]	Cumulative Plankton volumes	Plankton volume per haul	Daily Ratio[2]
			ml.	*ml.*	*N/D*
I	D: 0810 - 0740	1 - 15	696	46.40	5.34
	N: 1905 - 0050	17 - 25	2,209	245.44	
II	D: 0810 - 1715	1 - 13	590	45.38	1.87
	N: 1900 - 0240	15 - 25	935	85.00	
III	D: 0810 - 1710	1 - 13	662	50.92	2.12
	N: 1845 - 0250	15 - 25	1,186	107.82	
IV	D: 0810 - 1735	1 - 13	480	36.92	2.30
	N: 1915 - 0240	15 - 25	935	85.00	
V	D: 0810 - 1720	1 - 14	1,038	74.14	1.09
	N: 1925 - 0100	17 - 25	730	81.11	
	5-day ratio ml. per haul N/D: 2.38				

[1] Small organisms only (see table 1)
[2] Stations omitted if taken at or one-half hour before or after sunset
[3] Based on plankton volume per haul

volumes, and these were near the center of the grid.

Ratios of night and day hauls were determined for the plankton volumes by dividing the grid stations in the same manner as was done for the larvae of *Leuroglossus stilbius* and *Lampanyctus mexicanus*.

The 5-day ratios of volumes on the grids showed 2.38 times as much plankton collected at night as in the day (table 15), while the same ratios on the drogue and anchor stations respectively showed 1.47 and 1.46 times as much plankton collected at night as in the day (table 16).

The histograms for the drogue and anchor stations (fig. 7) show the changes in volume caused by diurnal migration; generally increasing to a maximum at night and decreasing to a minimum in the day.

Table 16.--Night and day collections of plankton volumes on drogue and anchor stations[1]

Day	Drogue stations							Anchor stations						
	Day hauls (D)			Night hauls (N)				Day hauls (D)			Night hauls (N)			
	Station	Volume per haul	Average volume per haul	Station	Volume per haul	Agerage volume per haul	Daily ratio[2]	Station	Volume per haul	Average volume per haul	Station	Volume per haul	Average volume per haul	Daily ratio[2]
		ml.	*ml.*		*ml.*		*N/D*		*ml.*	*ml.*		*ml.*	*ml.*	*N/D*
1	1	26		4	60			1	17		4	58		
	2	30		5	67			2	40		5	41		
	3	48		6	84			3	32		6	40		
			34.67			70.33	2.03			29.67			46.33	1.56
2	7	49		10	88			7	45		10	61		
	8	47		11	67			8	42		11	61		
	9	42		12	NS[3]			9	56		12	66		
			46.00			77.50	1.68			47.66			62.67	1.31
3	13	52		16	88			13	47		16	64		
	14	50		17	90			14	33		17	56		
	15	63		18	98			15	37		18	60		
			55.00			92.00	1.67			39.00			60.00	1.54
4	19	59		22	90			19	70		22	74		
	20	130		23	99			20	58		23	77		
	21	46		24	84			21	42		24	72		
			78.33			91.00	1.16			56.67			74.33	1.31
5	25	99		28	127			25	45		28	72		
	26	99		29	139			26	39		29	72		
	27	96		30	117			27	48		30	74		
			98.00			127.67	1.30			44.00			72.67	1.65
Total		936			1,298				651			948		

5-day ratio ml. per haul N/D:Drogue - 1.47
Anchor - 1.46

[1] Small organisms only (see table 1).
[2] Based on plankton volume per haul.
[3] NS - No sample.

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